

Original Article

Identifying determinants of effective complementary feeding behaviour change interventions in developing countries

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Abstract

As stunting moves to the forefront of the global agenda, there is substantial evidence that behaviour change interventions (BCI) can improve infant feeding practices and growth. However, this evidence has not been translated into improved outcomes on a national level because we do not know enough about what makes these interventions work, for whom, when, why, at what cost and for how long. Our objective was to examine the design and implementation of complementary feeding BCI, from the peer-reviewed literature, to identify generalisable key determinants. We identified 29 studies that evaluated BCI efficacy or effectiveness, were conducted in developing countries, and reported outcomes on infant and young children aged 6–24 months. Two potential determinants emerged: (1) effective studies used formative research to identify cultural barriers and enablers to optimal feeding practices, to shape the intervention strategy, and to formulate appropriate messages and mediums for delivery; (2) effective studies delineated the programme impact pathway to the target behaviour change and assessed intermediary behaviour changes to learn what worked. We found that BCI that used these developmental and implementation processes could be effective despite heterogeneous approaches and design components. Our analysis was constrained, however, by the limited published data on *how* design and implementation were carried out, perhaps because of publishing space limits. Information on cost-effectiveness, sustainability and scalability was also very limited. We suggest a more comprehensive reporting process and a more strategic research agenda to enable generalisable evidence to accumulate.

Keywords: behaviour change interventions, infant and young child nutrition, complementary feeding.

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Introduction

Undernutrition is the underlying cause of 45% of death for children under 5 years (Black *et al.* 2013). Early childhood nutritional deficiencies lead to inadequate growth, which in turn impairs brain development, creates academic difficulties and can lead to a lifetime of diminished earning capacity and an elevated risk of non-communicable diseases (Victoria *et al.* 2008). Longitudinal studies indicate that if nutri-

tional deficiencies are not treated by 2 years of age, the intellectual, health and human capital consequences are likely to be irreversible.

The 2008 Lancet Nutrition Series compiled the data from a proven set of interventions focused on the ‘window of opportunity’ from pregnancy to 2 years of age to demonstrate the potentially high impact their implementation would have on reducing death and disease and averting longer-term harm. The most recent Lancet Nutrition series, published June 2013,

highlights the causal role of fetal undernutrition as a risk factor for stunting, and emphasises the integration of nutrition interventions with improvements in health and hygiene behaviour and other nutrition-sensitive interventions (Black *et al.* 2013). It also reinforces the evidence for behaviour change interventions (BCI) in improving complementary feeding practices and linear growth (Bhutta *et al.* 2013).

Several recent systematic reviews have demonstrated that BCI have the potential to improve child feeding practices, nutritional status and growth (Caulfield *et al.* 1999; Bhutta *et al.* 2008; Dewey & Adu-Afarwuah 2008; Imdad *et al.* 2011; Shi & Zhang 2011). These reviews provide evidence to support the role of BCI as part of a global comprehensive approach to improving infant and young child nutrition. BCI as a fundamental policy strategy figure prominently in the recently published 'Special Issue on Promoting Healthy Growth and Preventing Childhood Stunting', supported by the World Health Organization (WHO) (*Maternal and Child Nutrition Study Group* 2013). It is particularly central in the discussions of 'key principles to improve programmes and interventions in complementary feeding' (Lutter *et al.* 2013); 'designing appropriate complementary feeding recommendations' (Daelmans *et al.* 2013) and 'contextualizing complementary feeding in a broader framework for stunting prevention' (Stewart *et al.* 2013). At the same time, a supplement on *Designing large-scale programs to improve infant and young child feeding in Asia and Africa: Methods and lessons of Alive & Thrive*, published in the *Food and Nutrition Bulletin* (Piwoz *et al.* 2013) highlights the role of BCI as a powerful intervention strategy.

In contrast to previous work, which has focused on developing the evidence base for BCI, the purpose of this paper is to contribute to the growing body of knowledge and support progress towards a strong theoretical foundation for BCI through a systematic identification of the key determinants of effective BCI. We characterise BCI as effective, using the dictionary definition 'producing a result that is wanted: having an intended effect' (Merriam Webster 2013). This is in contrast to the epidemiological definition, 'a measure of the extent to which a specific intervention ... when deployed in the field, does what it is intended to do for a defined population' (Porta 2008). The difference between popular definitions of effectiveness, which we employ here and technical epidemiological usage, which differentiates efficacy and effectiveness based on research design is a source of confusion in both nutrition and BCI discourse. We examine what is known about design and implementation of BCI, highlight examples to illustrate best practices and identify issues that need further attention. We also examine the extent to which studies have been concerned with issues of cost-effectiveness, sustainability and scalability.

The term BCI, as used in this paper, refers to programmes and activities that are specifically aimed at changing behaviours, either of programme recipients or the actors in the delivery system or both, and which may include related interventions (such as supplements or improved access to health care). Thus, it encompasses behaviour change communication (BCC), which is defined as 'evidence and research-based process of using communication to promote behaviors that lead to improvements in health out-

Key messages

- Effective behaviour change interventions (BCI) utilise two critical determinants: thoughtful formative research to develop and implement the intervention and a hypothesis of the programme impact pathway with assessment of intermediary behaviour outcomes.
- Peer-reviewed BCI studies rarely probe the 'black box' of what works, for whom, when, why, at what cost and for how long.
- Effective, evidence-based complementary feeding BCI have not yet been applied on a large enough scale to improve infant and young child nutrition in populations with undernutrition.
- BCI studies have generally not included attention to cost-effectiveness, sustainability or scalability.
- Provision of BCI detail related to potential determinants and a more strategic research agenda that compares different behaviour change approaches will enable generalisable evidence to accumulate.

comes' (The Manoff Group 2012). We use the term BCI rather than the SBCC (Social and Behavioral Change Communication) because the interventions we examined did not include the more comprehensive process of SBCC, which is defined as 'a research-based, consultative process that uses communication to promote and facilitate behavior change and support the requisite social change for the purpose of improving health outcomes' (The Manoff Group 2012).

Materials and methods

Search strategy

A search was conducted for peer-reviewed articles in PubMed, EBSCO and Popline through November 2012. The WHO, UNICEF, World Bank and CORE Group websites were also searched. References in published studies were also reviewed, as well as references in systematic reviews of complementary feeding interventions that specifically focused on behaviour change or nutrition education (Bhutta *et al.* 2008; Caulfield *et al.* 1999; Dewey & Adu-Afarwuah 2008; Imdad *et al.* 2011; Shi & Zhang 2011).

Inclusion criteria

Peer-reviewed articles were included if they met the following criteria: (1) evaluated complementary feeding interventions, which could include the use of family foods, the provision of supplements or commercially available fortified complementary foods; (2) described components of the behavioural change strategy development and implementation; (3) were conducted in developing countries; and (4) reported outcomes on children aged 6–24 months. Although studies that included breastfeeding were not excluded, because of the focus on the 6–24 month age group, studies that promoted exclusive breastfeeding were likely excluded from this review.

Data abstraction

We extracted the following data from each article: general information (including authors, publication

year, country); study design (including sample characteristics, number of sessions and length of follow-up); and available information on the formative research, the BCI approach, type of intervention facilitator, communication strategy and key messages (provided in Table 1). We also looked at BCI impact, which, depending on the study, included anthropometric change, nutritional intake, and/or feeding and care practice behaviours. Outcomes were assessed by noting whether they were positive (desired direction) or negative (undesirable direction) and statistically significant. Cost-effectiveness, scalability and sustainability were examined if data on these parameters were available.

Results

The results are organised in relation to potential key determinants of effectiveness, with examples provided to illustrate effective strategies, insights or approaches.

Study characteristics

The search process yielded 29 studies that met the selection criteria. These were conducted in 13 countries (Bangladesh, Brazil, China, Ecuador, India, Indonesia, Iran, Kenya, Madagascar, Malawi, Mexico, Peru, Vietnam). Twelve were efficacy studies, most frequently using a cluster randomised design and 17 were programme effectiveness trials that used a randomised or quasi-experimental design. Sample sizes ranged from 105 to 1200 children, with only two of the 29 studies enrolling less than 200 children (105 and 142). These sample sizes had sufficient power to detect meaningful differences in nutrition behaviour and growth outcomes. Participants represented diverse sociocultural settings. The studies ranged from 1 month to 5 years and follow-up assessments were conducted from immediately post-intervention (15 studies) to 4 years post-intervention (one study). This highly variable study duration and follow-up made it difficult to draw conclusions about impact, and potentially introduced an important bias as over half the studies were evaluated immediately post-intervention.

Table 1. Behaviour change interventions description and impact

Author/date/location	Study design	Formative research	Platform/facilitator	Communication strategy/messages	Impact
Aboud <i>et al.</i> /2008/ Bangladesh	<ul style="list-style-type: none"> • Randomised efficacy study • 202 children, 12–24 months • 6 sessions • 5 months follow-up 	Pilot, discussion groups and observations informed strategy and messages	Community-based/Peer educators <ul style="list-style-type: none"> ◦ Added to usual 12-week programme 	Self-feeding and responsive feeding <ul style="list-style-type: none"> • Wash your child's hands, and then let the child pick up food and eat • Read your child's signals and then respond positively • When your child refuses, pause and question why; don't force feed or threaten • Offer variety of foods. 	Physical growth Weight (+) Weight gain (+) Behaviour change Self-fed mouthfuls (+) Mouthfuls eaten (+) Mother's responsiveness (ns) Non-responsive encouragement (+) Forceful feeding (ns)
Aboud <i>et al.</i> /2009/ Bangladesh	<ul style="list-style-type: none"> • Randomised efficacy study • 203 children, 8–20 months • 6 sessions • 5 months follow-up 	Pilot, discussion groups, observations, and previous research informed strategy and messages	Community-based/Peer educators <ul style="list-style-type: none"> ◦ Added to usual 12-week programme 	Self-feeding and responsive feeding <ul style="list-style-type: none"> • Wash your child's hands; let the child pick up food and eat • Read your child's signals and then respond positively • When your child refuses, pause and question why; don't force feed or threaten • Offer variety of foods. 	Physical growth Weight gain (ns) Behaviour change Self-fed mouthfuls (+) Mother's responsiveness (+) Mouthfuls eaten (ns) Mother washed child's hands (+)
Aboud <i>et al.</i> /2011/ Bangladesh	<ul style="list-style-type: none"> • Randomised efficacy study • 302 children, 8–20 months • 6 sessions • 5 months follow-up • 3 groups: <ul style="list-style-type: none"> ➢ Intervention only (INV) ➢ Intervention + Sprinkles (INV+MNP) ➢ Control 	Pilot, discussion groups, observations, and previous research informed strategy and messages	Community-based/Peer educators <ul style="list-style-type: none"> ◦ Added to usual 12-week programme ◦ Provided Sprinkles for one group 	Self-feeding and responsive feeding <ul style="list-style-type: none"> • Wash your child's hands, and then let the child pick up food and eat • Read your child's signals and then respond positively • When your child refuses, pause and question why; don't force feed or threaten • Responsive stimulation during play • Offer variety of foods 	Physical growth Weight (+) Weight/age (ns) Length/age (ns) Behaviour change Self-fed mouthfuls (+) Mother's verbal responsiveness (ns) Mouthfuls eaten (+) Mother washed child's hands (+) Language skills (+)
Bhandari <i>et al.</i> /2001/ India	<ul style="list-style-type: none"> • Randomised effectiveness study • 418 infants, 4 months old • 2x/week + 1 hour/month • 4 groups: <ul style="list-style-type: none"> ➢ INV + Cereal ➢ INV ➢ Visitation group ➢ Nothing • Pre-post 8-month programme 	No description	Community-based Nutritionist <ul style="list-style-type: none"> ◦ Provided milk-based cereal 	Negotiated decision-making process	Physical growth Weight (vs visitation group) <ul style="list-style-type: none"> ➢ INV + Cereal (+) ➢ INV (ns) Length (ns) Behaviour change BF (INV + Cereal) (–)
Bhandari <i>et al.</i> /2004/ India	<ul style="list-style-type: none"> • Randomised effectiveness study • 1025 newborns • Various dosages: (1/month × 12 months) + (at 15 and 18 months) = 14 total + vaccination and sick child visits • Pre-post 18-month programme 	Stated that qualitative and quantitative research informed target behaviours, message and channels, but gave no detail	Community-based/Health care workers, village workers and auxiliary nurses	<ul style="list-style-type: none"> • CF at 6 months • Specific foods • Frequency and quantity + BF • Methods to encourage children to eat more • Hand washing before meals • Feeding during illness 	Physical growth Length gain (+) Weight gain (ns) Behaviour change Responsive feeding (+) Encouraged actively (+) Fed with love and affection (+) Hand washing (+) Other: Energy intake (+) Morbidity (ns)
Bonvecchio <i>et al.</i> /2007/ Mexico	<ul style="list-style-type: none"> • Randomised efficacy study • 374 families with infants 6–23 months • Various dosages • Pre-post 5-month programme 	Qualitative and quantitative research informed target behaviours, message and channels	Community-based/Community volunteers and health care workers during routine visits <ul style="list-style-type: none"> • Provided <i>papilla</i> 	<ul style="list-style-type: none"> • Prepare <i>papilla</i> with 4 tbsps of powder and 3 tps of water • Give <i>papilla</i> every day • Give <i>papilla</i> between meals, • Give <i>papilla</i> only to target children. 	Behaviour change Prevalence for three of four behaviours (+)

Table 1. Continued

Author/date/location	Study design	Formative research	Platform/facilitator	Communication strategy/messages	Impact
de Romana <i>et al.</i> /2000/ Peru	<ul style="list-style-type: none"> • Randomised effectiveness study • 500 children 6–36 months • Various dosages • Pre-post 1-year programme 	Qualitative research and acceptability trials informed product formulation and distribution	Community-based/ Community volunteers • Provided CF (<i>Alli Alimantu</i>)	<ul style="list-style-type: none"> • Increase awareness of <i>Alli Alimantu</i> • Increase awareness of the nutrition project • BF promotion • Instructions on food preparation 	Physical growth Height (ns) Weight (ns) Other Consumption of nutrients (+) Micronutrient status (+) Anaemia (+)
Guldan <i>et al.</i> /2000/ China	<ul style="list-style-type: none"> • Quasi-experimental efficacy study • 495 children, 4–12 months • Monthly growth monitoring and counselling • Pre-post 1-year programme 	Quantitative needs assessment informed target behaviours	Community-based/Village nutrition educators	<ul style="list-style-type: none"> • Breast milk is best for first 4–6 months • Post-birth BF • Bottle feeding may be dangerous and BF is free • BF on demand • Appropriate foods 	Physical growth Weight (+) Height (+) Other Anaemia: (+) BF rates: (+) Knowledge: (+)
Guyon <i>et al.</i> /2009/ Madagascar	<ul style="list-style-type: none"> • Cross-sectional effectiveness study • 1200 children under 2 at baseline; 1760 at end line • Various dosages • Pre-post 5-year programme 	No description	Community and health centre-based media/ Various health care and community facilitators	<ul style="list-style-type: none"> • ‘The right ENA message, at the right time, to the right target group’ • Small ‘doable actions’ with age-specific recommendations • Specific messages: <ul style="list-style-type: none"> ➢ Age-appropriate CF ➢ Continued BF ➢ Food frequency, diversity and quantity • Feasible home food enrichment 	Behaviour change Food frequency (+) Fed during illness (ns) Vitamin A (+) Food quantity (+) Other BF rates (+) % dewormed (+) Food diversity (ns)
Hotz & Gibson/2004/ Malawi	<ul style="list-style-type: none"> • Quasi-experimental efficacy study • 105 children, 9–23 months • 4 weekly groups + home visit • 4-week follow-up 	No description	Community-based/ Community volunteers	<ul style="list-style-type: none"> • Increase the energy density of porridges • Methods to increase intake of iron and zinc • Enrichment of <i>phalas</i> with energy and nutrient dense foods • Encourage children to eat 	Behaviour change Adoption rates (+) Other Quantity of CF food (+) Micronutrient intake (+) Animal intake (+)
Inayati <i>et al.</i> /2012/ Indonesia	<ul style="list-style-type: none"> • Randomised, efficacy study • 215 children, 6–60 months • Various dosages • 4 groups <ul style="list-style-type: none"> ➢ Intensive nutrition education ➢ Intensive education + MNP ➢ Non-intensive education ➢ Non-intensive education + MNP • Pre-post discharge 	Qualitative research informed target behaviour	Community-based/ Health and nutrition officers and community volunteers • Provision of MNP	Importance of: <ul style="list-style-type: none"> • Healthy family meals • Food safety • Feeding infants and young children • Feeding sick children • Prevention and treatment of malnutrition 	Physical growth Weight gain (+) Other Length of stay (+) Hb value (+)
Kapur <i>et al.</i> / 2003/India	<ul style="list-style-type: none"> • Randomised efficacy study • 451 children, 9–36 months • 8 weekly sessions • 8 weeks follow-up 4 groups: <ul style="list-style-type: none"> ➢ Nutrition education ➢ Weekly iron ➢ Nutrition education + weekly iron ➢ Placebo control 	Surveys informed strategy message and channels	Community-based/ Anganwadi workers • Provision of iron	<ul style="list-style-type: none"> • Exclusive BF for 6 months • CF by 6 months • Appropriate foods (consistency, quality and quantity) • Small, frequent meals • Family food by 1 year • More solids, less milk • Hygiene • Knowledge of anaemia • Iron-rich and Vitamin C foods 	Other Iron intake (+) Serum ferritin levels (+) Prevention of declines in iron status (+) Maternal knowledge (+)

Table 1. Continued

Author/date/location	Study design	Formative research	Platform/facilitator	Communication strategy/messages	Impact
Kilaru <i>et al.</i> /2005/India	<ul style="list-style-type: none"> Effectiveness study (not randomised) 242 infants, 5–11 months 12 monthly monitoring and counselling 1-year follow-up 	Used data from Bhandari studies	Community-based/Educated workers	<ul style="list-style-type: none"> Use and preparation of appropriate local foods Feeding frequency Increase food diversity CF then BF Avoid bottles 	Physical Growth Weight: Girls (+) Boys (ns) Behaviour Change 4 of 6 behaviours, Girls (+); Boys (ns) Solids 4x/day (+) 5 food groups (+)
Li <i>et al.</i> /2007/Dai minority in China	<ul style="list-style-type: none"> Cross-sectional effectiveness study 352 newborns Various dosages, with growth monitoring bimonthly Pre-post 2-year programme 	Community partners contributed to strategy, message and channels	Community-based/Health workers, community, village representatives	<ul style="list-style-type: none"> Support for early initiation and continued BF Quality/quantity of CF Instructions on child feeding Preparation of foods Overcoming food taboos (egg, liver, fish) 	Physical growth Weight change (+) Behaviour change Earlier BF (+) Earlier initiation of indicated foods and later of rice (+) Consumption of taboo foods (+)
Lutter <i>et al.</i> /2008/Ecuador	<ul style="list-style-type: none"> Quasi-experimental, non-randomly chosen control 634 children, 9–14 months Various dosages including weekly monitoring Pre-post 11-month programme 	No description	Community-based/Health and community workers, parent committees <ul style="list-style-type: none"> Provision of MNP CF (<i>papilla</i>) 	<ul style="list-style-type: none"> Awareness of good nutrition during childhood Inform families and communities about the programme, and encourage enrolment 	Physical growth Less likely to be underweight (+) Growth (ns) Behaviour change CF quantity and quality (+) BF practices (ns) Other Haemoglobin (+) Anaemia (+)
Mackintosh <i>et al.</i> /2002/Vietnam	<ul style="list-style-type: none"> Cross-sectional programme evaluation 142 younger siblings of children in 1st study Daily, 2 weeks/month, growth, monitoring, and promotion 3- and 4-year follow-up 	Positive Deviance method informed intervention content	Community-based/Villagers <ul style="list-style-type: none"> Part of Poverty Alleviation and Nutrition Program (PANP) 	Basic UNICEF 'Facts for Life' messages	Physical Growth Younger siblings (+) Weight/age (+) Weight/height (+) Height/age (ns) Behaviour change Food frequency (+) Washed hands (+)
Pachón <i>et al.</i> /2002/Vietnam	<ul style="list-style-type: none"> Randomised effectiveness trial 238 children, 5–25 months Daily, 2 weeks/month, growth, monitoring and promotion 	Positive Deviance method informed intervention content	Community-based/Villagers	<ul style="list-style-type: none"> Feed children PD 'good foods' Increase food quantity Feed 5–6 times/day Continue breastfeeding Other health-seeking and caring behaviours 	Behaviour change PD foods eaten (+) Frequency and quantity (+) Consumed more energy (+) BF frequency or prevalence (ns)
Penny <i>et al.</i> /2005/Peru	<ul style="list-style-type: none"> Randomised effectiveness study 377 infants, at birth Growth, monitoring and promotion Various dosages Pre-post 18-month programme 	Structured observations and cross-sectional survey informed strategy, messaging and medium	Health centre-based/Health care providers	<ul style="list-style-type: none"> A thick puree satisfies and nourishes your baby, equal to three portions of soup Add a special food to your baby's serving (chicken, liver, egg or fish) everyday Teach your child to eat with love, patience and good humour 	Physical growth Stunting (+) Weight (+) Weight/age (+) Height (+) Height/age (+) Behaviour change: Care practices (+) BF rates (ns) Preventive healthcare (+) Animal sources (+)
Rivera <i>et al.</i> /2004/Mexico	<ul style="list-style-type: none"> Randomised effectiveness study 650 children, 4–23 months 1 education session + regular monitoring 1-year follow-up 	No description	Community-based/Unspecified facilitators <ul style="list-style-type: none"> Part of incentive-based welfare programme Provided fortified food supplements 	<ul style="list-style-type: none"> General nutrition and health 	Physical growth Height (+) (highest for infants < 6 months and the poorest infants) Other: Haemoglobin at 18 months (+) Haemoglobin at Y2 (ns) Anaemia (+)

Table 1. Continued

Author/date/location	Study design	Formative research	Platform/facilitator	Communication strategy/messages	Impact
Roy <i>et al.</i> /2005/Bangladesh	<ul style="list-style-type: none"> Randomised effectiveness 282 children, 6–24 months 2x/week, 3 months 6-month follow-up <p>3 groups:</p> <ul style="list-style-type: none"> Intensive nutrition education (INE) Intensive nutrition education +supplemental food (INE + SF) Non-intensive nutrition education 	No description	<ul style="list-style-type: none"> Community-based/Health assistants Food ration supplement 	<ul style="list-style-type: none"> Importance of BF (UNICEF nutrition triangle) Importance of food security, caring practices, personal hygiene and disease control Nutritional properties of food ingredients Risks of malnutrition and how to achieve good nutrition 	<p>Physical growth</p> <ul style="list-style-type: none"> Weight/age (+) <p>Behaviour change</p> <ul style="list-style-type: none"> Separate pots (+) Feeding frequency (+) Cooking CF (+) <p>Other</p> <ul style="list-style-type: none"> Nutritional status (+) No significant difference in nutritional status between INE and INE+SF groups vs. control
Roy, <i>et al.</i> /2007/Bangladesh	<ul style="list-style-type: none"> Randomised effectiveness study 605 children, 6–9 months Weekly for 3 months + 2x week for 3 months 6-month follow-up 	Qualitative groups of study mothers informed strategy, message and materials	<ul style="list-style-type: none"> Community-based/Community health workers 	<ul style="list-style-type: none"> (UNICEF nutrition triangle) Importance of food security, caring practices, personal hygiene and disease control Use separate feeding pots Prevention and control of diarrhoea and acute RTI Promotion of <i>khichuri</i> (a local CF) as energy- and protein-rich Responsive feeding 	<p>Physical growth</p> <ul style="list-style-type: none"> Weight gain (+) Weight/age (+) Length/age (+) <p>Behaviour change</p> <ul style="list-style-type: none"> Frequency (+) Separate pots (+) <p>Cost</p> <ul style="list-style-type: none"> Malnutrition prevention Range through districts of US\$37 to US\$21.34
Salehi <i>et al.</i> /2004/Iran	<ul style="list-style-type: none"> Quasi-experimental efficacy study 811 children, 0–59 months Various dosages 12-month programme 3 months follow-up 	Used Hubley's (1993) BC model to guide quantitative and qualitative research, inform behaviours, and develop strategy and messages	<ul style="list-style-type: none"> Community-based/Literate daughters and influential people + health care workers 	<p>18 messages including:</p> <ul style="list-style-type: none"> Clean drinking water Vaccination Child growth and illness monitoring Food pyramid Hygiene Age-appropriate CF 	<p>Physical growth</p> <ul style="list-style-type: none"> Weight (+) Height (+) Weight/age (+) Height/age Z (+) Weight/height (+) <p>Behaviour change</p> <ul style="list-style-type: none"> % protein from animal sources (+) Food variety (+)
Santos <i>et al.</i> /2001/Brazil	<ul style="list-style-type: none"> Randomised efficacy study 424 children, <18 months 20 hours training for doctors Various dosages for children 6-month follow-up 	In-depth interviews with 30 mothers and household trials informed behaviours, strategy and messages	<ul style="list-style-type: none"> Health centre-based/Doctors 	<ul style="list-style-type: none"> IMCI guide for physicians to use in counselling: Increase frequency of BF and CF Give animal protein and micronutrient-rich foods Add oil to food Increase energy and nutrient food density 	<p>Physical growth</p> <ul style="list-style-type: none"> Weight/age (+) Weight/height (+) Weight gain (+) Height (ns) <p>Behaviour change</p> <ul style="list-style-type: none"> Dr.'s nutrition assessment and counselling skills (+) Quantity and density (ns)
Schroder <i>et al.</i> /2002/Vietnam	<ul style="list-style-type: none"> Randomised effectiveness study 238 children, 5–25 months Daily, 2 weeks/month Pre-post 1-year 	Positive Deviance method with four families informed intervention content	<ul style="list-style-type: none"> Community-based/Community members 	<ul style="list-style-type: none"> Feeding children 'good foods' (i.e. PD foods) Educating mothers in good caretaking practices based on UNICEF's Facts for Life 	<p>Physical growth</p> <ul style="list-style-type: none"> Growth (ns) Younger (<15 months) and more malnourished (<-2 Z) deteriorated significantly less <p>Other</p> <ul style="list-style-type: none"> Dietary intake (+) Morbidity (+)
Suchdev <i>et al.</i> /2012/Kenya	<ul style="list-style-type: none"> Randomised effectiveness study 1063 baseline; 862 post children, 6–35 months Variable dosage Pre-post 1-year programme 	Quantitative survey and 14 focus groups with caregivers, vendors, consumers informed strategy	<ul style="list-style-type: none"> Social Marketing/Community-based distribution system 	<ul style="list-style-type: none"> 'Happy child; happy family' Rationale, benefits and appropriate use of product 	<p>Behaviour change</p> <ul style="list-style-type: none"> Purchase intention (+) Purchases (+) Average weekly intake/child (+) <p>Other</p> <ul style="list-style-type: none"> Haemoglobin (+) Iron (+) Vitamin A (+)

Table 1. Continued

Author/date/location	Study design	Formative research	Platform/facilitator	Communication strategy/messages	Impact
Sun <i>et al.</i> / 2011/China	<ul style="list-style-type: none"> • Randomised effectiveness study • 226 baseline; 221 post, 6–24 months • Variable dosage • Pre-post after 8-month programme 	Used quantitative research on Theory of Planned Behaviour and Health Belief Model to inform six-P strategy	Social marketing/ <ul style="list-style-type: none"> • Social marketing of Ying Yang Bao (YYB) MNP through health system, public-private partnership, mass media 	<ul style="list-style-type: none"> • Appropriate CF and use of YYB • Project background, sale locations, price, usage instructions 	Behaviour change Intention to buy (+) Ever purchased (+) Ever used (+) Other Anaemia in general population (ns) For purchasers, odds ratio for risk of anaemia (+)
Tomedi <i>et al.</i> / 2012/Kenya	<ul style="list-style-type: none"> • Non-randomised efficacy study • 276 children, 6–20 months • 7 monthly sessions • Pre-post 7-month programme 	No description	Community-based/ Community health workers <ul style="list-style-type: none"> • Monthly food rations 	<ul style="list-style-type: none"> • From WHO 'Guiding Principles for CF of the BF Child' • Hand washing • Hygienic food preparation • Offer diversity of local foods 	Physical growth Weight gain (+) Weight/height (+) Height/age: (ns) Wasting (+) Other Micronutrient intake (+)
Zaman <i>et al.</i> / 2008/Pakistan	<ul style="list-style-type: none"> • Randomised efficacy study • 375 children, 6–24 months • Various dosages • 5 ½ days training for LHV • Pre-post 6-month programme 	Replicated Brazil (Santos <i>et al.</i> 2001 study) No further description	Health centre-based/Lady Health Visitors (LHV) using IMCI training	<ul style="list-style-type: none"> • IMCI messages 	Physical growth: Weight gain (+) Weight/age (+) Height/age (ns) Behaviour change: LHV skills (+) Animal source food (+)
Zhang <i>et al.</i> / 2012/China	<ul style="list-style-type: none"> • Randomised effectiveness study • 599 children, 2–4 months • Daily, 2 weeks/month, growth monitoring and promotion • 18-month follow-up 	Literature review and qualitative research with health care providers informed strategic messages	Community-based/Health care providers	<ul style="list-style-type: none"> • Food selection, preparation and hygiene (especially animal-source protein) • Childhood nutrition and growth • Responsive feeding 	Physical growth Weight for age (+) Weight for height (+) Behaviour change Diversity (+) Frequency (+) Animal sources (+) Other Hand washing (+) Cook separately (+) BF frequency (+)

BC, behavior change; BF, breast feeding; CF, complementary feeding; ENA, Essential Nutrition Actions; INE, intensive nutrition education; IMCI, Integrated Management of Childhood Illness; MNP, Micronutrient powder; PD, Positive Deviance; RTI, Respiratory tract infection; SF, supplemental food.

Impact

As per search strategy criteria, interventions reported outcomes for impact on infant growth, micronutrient intake or target behaviour change (Table 1). Given the heterogeneity of the intermediate and impact indicators, it was difficult to compare effectiveness across studies. Growth-related outcomes were the most common indicators, although studies used diverse measures (i.e. average weight and height; changes in weight and height; or reduction in stunting). Of the 22 studies that assessed growth, 19 reported significant gains in growth with more evidence for weight than height, although this preponderance of benefit may reflect publication bias. The

recent meta-analysis of BCI studies by Imdad *et al.* (2011) reported pooled impact weight gains of 0.30 kg (+/- 0.26) and height gains of 0.49 cm (+/- 0.50). Although the studies were not intended to address disparities, two studies showed significant outcomes only for vulnerable subgroups of the study population, such as the youngest or most malnourished children or girls (Schroeder *et al.* 2002; Kilaru *et al.* 2005).

The 2013 Lancet Nutrition series present a framework for actions to achieve optimum fetal and child nutrition and development that acknowledged the critical importance of context in nutritional interventions. Food security was the most common contextual determinant considered in the design of the studies

reviewed, while seven studies assessed hand washing, five studies assessed caregiver responsiveness, five studies assessed co-morbidities, and two looked at community norms and/or caregiver's empowerment. All of these non-food security-focused studies reported positive changes in the direction of the behaviours indicated. Eleven studies assessed the impact of supplements or fortified foods in addition to the BCI. Five of those studies compared the outcomes from the BCI-plus-supplementation group to outcomes of a control group. Two of the five studies reported significant impact on growth; two reported non-significant impact on growth; and one reported significant impact on micronutrient status (de Romaña 2000; Kapur *et al.* 2003; Rivera *et al.* 2004; Lutter *et al.* 2008; Tomedi *et al.* 2012). Four studies used a three-arm design to test: (1) a group with a BCI-plus-complementary food (cereal and iron tablets in India, cereal in Bangladesh and Sprinkles in Indonesia and Bangladesh); (2) a group with a BCI-only; (3) a comparison group without either intervention (Bhandari *et al.* 2001; Roy *et al.* 2005; Aboud & Akter 2011; Inayati *et al.* 2012). Compared with the control groups, the groups that received a BCI-plus-complementary feeding intervention demonstrated larger weight gains than the BCI-only groups. Two additional studies reported behaviour change from social marketing of fortified products (Sprinkles in Kenya and Ying Yang Bao in China), but did not use a control group design (Penny *et al.* 2005; Suchdev *et al.* 2012a).

All the interventions assessed either proximal outcomes, such as feeding and care behaviour change, or nutritional impact such as micronutrient status. Thirteen studies used at least one key message recommended in the WHO/UNICEF programming guide to infant and young child feeding (IYCF) (United Nations Children's Fund 2011), as a common standard to assess and report care behaviours, such as minimum dietary diversity, meal frequency and consumption of iron-rich foods. Eleven studies also reported improvements in feeding behaviours, such as self-fed mouthfuls, hygiene practices and the use of separate feeding pots or behaviours that impacted nutritional status and growth, such as hand washing, general food hygiene and timely care of a related illness.

Formative research

The majority of the studies reported the use of formative research to help identify local practices and barriers or enablers to optimal feeding practices; however, only about half the studies reported details on how the research was conducted or how it was used to formulate key messages. A few studies reported the identification of suboptimal feeding behaviours, such as the early initiation of thin liquids and the late introduction of solids in China and Mexico (Bonvecchio *et al.* 2007; Shi & Zhang 2011) or barriers that guided message development, such as mothers' financial and time constraints on childcare and the preparation of complementary feeding, in Bangladesh (Roy *et al.* 2005). Several studies used formative research to identify appropriate, acceptable and affordable local foods that could enable appropriate feeding practices and taught caregivers how to enrich their nutritional content. Examples include *huhu* in China (Guldan *et al.* 2000), *mi papilla* in Mexico (Bonvecchio *et al.* 2007) and *khichuri* in Bangladesh (Roy *et al.* 2005). Three studies that reported on Positive Deviance interventions used community-based formative research, as the method involved working with the community to identify members whose children were thriving despite adverse conditions and then utilised these feeding practices in the intervention (Mackintosh *et al.* 2002; Pachón *et al.* 2002; Schroeder *et al.* 2002). However, almost half the studies did not report substantive details on formative research. Six interventions did not provide data from formative research and four others did not provide details on the type of research conducted or how the data were used to develop the intervention strategy and the key messages.

BCI components

Messaging

Most interventions adapted the WHO/UNICEF IYCF practice recommendations (2008) to the local context. Only nine studies reported how messages were derived and most studies provided only a general message summary. The number of reported

messages ranged from as few as four, in a physician-led intervention in Peru (Penny *et al.* 2005), to as many as 18 messages for a community-based approach in Iran (Salehi *et al.* 2004).

Example 1: Formative research driving focused message development

A study in Mexico used formative research to identify why children were not benefiting from a nutritional supplement (*papilla*) with established biological efficacy and targeted the messages to the barriers identified (Bonvecchio *et al.* 2007). The formative research indicated that mothers typically mixed *papilla* with a substantial amount of water to create a thin drink rather than give it as a thick pap, and that a major reason for not giving it daily was that the ration was used up before the end of the month. The research also identified how and why the rations were depleted early: mothers typically prepared it more than once a day; *papilla* was served as a main meal instead of a food supplement; and mothers served the *papilla* to other children in the family. Based on this research, the strategy targeted four related feeding behaviours and created specific motivational messages: (1) prepare *papilla* with 4 tablespoons of powder and 3 tablespoons of water; (2) give *papilla* to your child every day; (3) give *papilla* to your child between meals; and (4) give *papilla* only to the target malnourished child. Despite concerns that busy caregivers would not adopt these new feeding behaviours, results showed that three of the four recommendations were acceptable to the mothers and easy for them to adopt. Importantly, the fourth recommendation, which had been identified as not culturally acceptable during the formative research, particularly to indigenous women, was often not adopted by mothers who had adopted the other recommendations. As one mother explained:

'When you have more than one child, and the three-year old (undernourished) is the only one that receives *papilla*, she is the only one that eats it, so the others start to cry. I feel sorry for them because we cannot give them the *papilla*, then I see that there is a problem. For this reason I think all the children in the family should receive the *papilla*.'

Delivery platform

Most studies utilised a community-based platform, with either an interpersonal or counselling approach for individualised motivation, problem solving and support, or a group-based approach for efficiency and peer support. These approaches required training facilitators in both content and process, and effectiveness was often dependent on the facilitators' counselling skills. Another community-based approach targeted influential people to address the normative roles played by mother-in-laws, community leaders or local political leaders. Only three interventions used a health centre-based approach, although many others used health workers in a community-based setting. Six studies extended the reach of their intervention with media, most typically local media, such as radio or cars with loudspeakers. Little detail was given about media spending or reach. In addition, three interventions utilised a social marketing approach that incorporated innovative delivery components, combined with a community-based platform and a media campaign.

Example 2: Using a community-based platform to modify traditional feeding practices

In Iran, researchers targeted influential people in the community to help change social norms about feeding behaviour (Salehi *et al.* 2004). The strategy was based upon Hubley's community-based behaviour change model, which highlights the importance of subjective norms (Hubley 1993). Influential tribal leaders and the educated daughters of the largely illiterate target mothers were recruited as champions to encourage the target feeding and care behaviours. Training was both in-class and experiential. Messages emphasised increased use of affordable energy and protein-rich foods, such as eggs, vegetables and legumes, and increased meal quantity and frequency. The leaders and daughters supported the communication with the caregivers and reinforced the desired feeding behaviours. The study presented data about intermediary and distal behaviour changes, with reported improvements in knowledge and attitudes of the mothers, enhanced cooperation from families,

increased consumption of protein-rich foods and decreased prevalence of undernutrition. The study also reported a correlation between the anthropometric outcomes and the mothers' attitudes.

Number of intervention sessions

The number of sessions in the studies ranged from a low of four to six, 2-h sessions for children with low levels of malnutrition, in Bangladesh and Malawi (Hotz & Gibson 2004; Aboud *et al.* 2008, 2009; Aboud & Akter 2011), to 24 sessions for an intervention delivered twice a week for 3 months in Bangladesh (Roy *et al.* 2005). The Positive Deviance sessions for malnourished children offered the largest potential exposure to caregivers, although these utilised a treatment approach rather than a preventive approach (Mackintosh *et al.* 2002; Pachón *et al.* 2002; Schroeder *et al.* 2002). In these interventions, village facilitators met with caregivers and the child daily, 2 weeks a month, for several months, until the child was no longer malnourished. Thirteen studies did not specify the specific number of sessions offered. In some cases this was because the intervention strategy opportunistically utilised contacts with health care providers during health-related visits so it was difficult to assess the frequency of interactions. None of the studies provided attendance rates for the interventions, so study exposure could not be reported.

Facilitator

Most interventions (23 of 29) were delivered through facilitators, typically paid community health workers or volunteer peer educators. Community interventionists were trained by health workers (doctors, nurses, staff), or non-government organisation (NGO) research staff. One intervention in India utilised a nutritionist as a facilitator (Bhandari *et al.* 2001). Four interventions used health care providers, in the clinic setting, to deliver the intervention (Santos *et al.* 2001; Penny *et al.* 2005; Li *et al.* 2007; Zaman *et al.* 2008).

Example 3: Demonstrating the intervention's programme impact pathway

In Brazil, a randomised trial studied the impact of training health workers to identify poor nutritional

status and associated care behaviours, and to provide counselling and follow-up recommendations (Santos *et al.* 2001). Based on detailed formative research, a programme impact pathway was hypothesised: (1) nutritional counselling training would lead to improvements in the knowledge and skills of health care providers regarding the assessment and management of nutritional and feeding problems; (2) improved provider knowledge and skills would enhance the ability of the providers to provide appropriate caregiver advice; (3) enhanced provider advice would improve caregiver's nutritional management attitude and behaviour; (4) caregiver's improved attitude and behaviour would increase the child's nutritional intake; and (5) improved intake would increase anthropometric growth. Health workers received 20 h of nutritional and counselling education and coaching. One month post-intervention, assessments demonstrated intermediary and distal behavioural impact along the programme pathway (improvements in doctor's knowledge, assessment and counselling practices, higher maternal recall of recommendations, increased use of recommended foods and weight gain).

Instruction methods

Most interventions applied principles of communication and adult learning to overcome challenges of working with caregivers with limited education. Multiple techniques were used, such as active learning, sustained recall and recipe demonstrations. Cooking demonstrations were used to engage the participants and to overcome barriers to trial and usage. Effective interventions explicitly encouraged problem solving or negotiations with the participants to maximise the changes they would be willing to make and participants were often given memory tools such as cards with recipes or pictures to aid recall (Salehi *et al.* 2004; Aboud & Akter 2011; Inayati *et al.* 2012). In contrast, the 'usual care' educational programmes typically used for control groups taught nutritional and feeding information didactically and did not involve the children.

Example 4: Effective use of adult learning techniques

A multicomponent, health care worker-led intervention in China used recipe demonstrations to

overcome cultural beliefs that negatively impacted feeding behaviour (Zhang *et al.* 2013). Traditional beliefs that ‘the baby doesn’t like egg or vegetables’ and that ‘egg, meat and cooking oil cannot be digested by the baby’, were identified as barriers to the recommended feeding practices. Based on the formative research, training sessions included demonstrations of recipes using appropriate ingredients, such as flour, egg, meat, green leafy vegetables, potatoes and cooking oil. Facilitators explained the benefits of the recommended foods for growth and addressed participants’ concerns about the feasibility, time and cost of preparing the recipes. The ease of preparation for the participants and the acceptance by the children encouraged caregivers to try the new recipes at home. The study reported significant improvements in caregiver knowledge and practice, intake of animal-source foods and weight for age, compared with the control group.

Cost-effectiveness, sustainability and scalability

Study data for cost-effectiveness, sustainability and ‘scaling up’ were limited:

Cost or cost-effectiveness

Only three studies provided cost data and their differing methodology made it difficult to compare costs either across studies or versus other sectors (Edejer 2003). None of the studies included opportunity costs, including in-kind contributions such as volunteer time. One study, in Peru, reported cost data calculated using activity-based costings, in a subsequent report of the study included in this review (Penny *et al.* 2005; Waters *et al.* 2006). The study computed programme expenses of US\$15.37 per child and of US\$138.50 per case of child stunting avoided but did compute cost per disability-adjusted life year (DALY). In Madagascar, the computed DALY of US\$30.77 was compared with other health interventions and the World Bank’s US\$100 upper limit for cost-effective programmes in low-income countries but no methodology was provided (Guyon *et al.* 2009). The third study, in Bangladesh, computed costs ranging from US\$21.34 to US\$37 for the four study sites by quantifying all

inputs used in the service delivery process, including time-motion studies, but did not provide analysis of the 50% cost variance between the sites nor costs per DALY data averted (Roy *et al.* 2007; Horton *et al.* 2010).

Sustainability

Many interventions utilised the existing health systems as a means of institutionalising the interventions for long-term sustainability, which assumed that the system could assume the budget, training and capacity. The health system was an effective delivery vehicle when the system was well organised and professional, such as in Peru (Penny *et al.* 2005). However, in India, where the health system was not strong, an intervention that trained health workers showed only small effects on growth (Bhandari *et al.* 2004). The study in Mexico (Bonvecchio *et al.* 2007) created a non-health system method for delivering messages when process evaluation revealed that the health service could not do so. Many studies used a health worker placed in the community to reduce training costs and supervision, in Bangladesh, China, Ecuador, India, Indonesia, Iran, Kenya and Madagascar, but they reported mixed outcomes.

Example 5: BCI delivered through the health system, implying sustainability

In Peru, Penny *et al.* (2005) demonstrated the effectiveness of an intervention that enhanced existing services with minimum additional resources, in the context of a strong health system. Formative research was mentioned as key to guiding intervention strategy and development, although no details were provided. Recognising that many health systems have high personnel turnover, the intervention used a systems approach to focus on improving the service itself as a unit, rather than improving the individual service providers. Staff and physicians were coached in nutrition and counselling skills, using theories of adult education and organisational change, and practice prompt tools, such as patient history forms, were introduced. The caregiver messages were specific and culturally appropriate. The intervention also included a high

profile facility accreditation scheme to institutionalise the changes. After the 18-month programme, the study demonstrated impact for intermediary and distal behaviour changes in caregiver knowledge, preventive health care-seeking behaviour, feeding practices and dietary intake, for the intervention group compared with the control group. The intervention also reported significant linear growth for the children, resulting in a reduction in stunting of two-thirds.

In Madagascar, a social marketing intervention demonstrated an alternative approach to sustainability by institutionalising the programme within existing and newly created organisations, from the national to the local level (Guyon *et al.* 2009). The project facilitated national and regional advocacy coalitions, which developed national guidelines and created an enabling policy environment. At the operational level, the nutrition coalitions fostered the involvement of partners in all aspects of programme design and implementation and promoted the harmonisation of approaches and messages, increased resources and broader reach. The coalitions also facilitated new community norms, which helped sustain behaviour change.

Scalability

Three programmes used social marketing to extend the reach of the interventions. Their development process included formative research to inform and optimise the micronutrient products' taste, nutritional benefit, affordability and ease of access (Smith *et al.* 2006). Social marketing techniques (i.e. marketing, public relations, and mass media), assessment measures (i.e. product awareness and sales) and tools (i.e. innovative distribution systems) were designed for application on a broad population basis. Although expensive, mass media was essential for behaviour change because it helped raise awareness, promote the product and encourage product purchase. Study outcomes were consumer awareness, purchases and product usage.

Example 6: Mirroring commercial marketing techniques to create broad demand

In Kenya, Sprinkles' social marketing plan used segmented qualitative and quantitative research to

develop the strategy and implementation plan (Suchdev *et al.* 2012a). Marketing strategies included an innovative community-based distribution system throughout the study's 60 villages and promotional tactics for consumers and the trade. During the intervention period, monitoring indicated disparities in reach and outcomes (awareness and sales) in remote villages, which rebounded after supplemental promotional efforts. After 12 months of activity, 95% of surveyed mothers were aware of the product and 33% of households had ever purchased the product. Average weekly intake of 0.9 sachets was lower than the nutritional recommendation, but the programme reported improvements in nutritional status for intervention children compared with control children. However, similar to other types of interventions, the intervention's benefits were not sustained without continued funding: research showed that by 18 months after the end of the marketing campaign, awareness and sales fell significantly and micronutrient deficiencies increased (Suchdev *et al.* 2012b).

In China, government developed a fortified micronutrient powder sachet, Ying Yang Bao (Sun *et al.* 2011) in partnership with a private company's distribution system. The taste, distribution system and marketing strategies were developed through consumer research. At the end of the 8-month programme, 59.6% were aware of the product; of those aware of the product, 22.6% had purchased it; and among those who purchased the product, 55.6% consumed it every day, 40.7% every other day and 2.7% occasionally.

The largest programme implemented, in Madagascar, was a social marketing intervention that reached a population of 1.4 million (Guyon *et al.* 2009). The strategy was developed from quantitative research conducted among members of the government, civil society and a NGO coalition. The intervention used a community-based platform, and a strong public relations campaign featuring a popular singer, to promote age-appropriate breastfeeding and complementary feeding messages within the Essential Nutrition Actions (ENA) framework. At the end of the 5-year programme, participants reported significant improvements in complementary feeding frequency, prevalence of the minimum adequate diet, deworming rates and appropriate care during childhood illnesses.

Discussion

Recent systematic reviews and best practice reports have confirmed the evidence for BCI but these reviews did not probe the 'black box' of the design and implementation processes in an attempt to identify determinants of effective behaviour change interventions (Dewey & Adu-Afarwuah 2008; Horton *et al.* 2010; World Health Organization, 2008). Although there were not enough standardised outcome data to document a causal relationship between formative research and impact, two potential determinants emerged from our analysis. First, effective studies conducted formative research and, most importantly, used the findings systematically to identify cultural barriers and enablers to optimal feeding practices, to shape the intervention strategy and to formulate appropriate messages and mediums for delivery. The formative research illuminated important, unique cultural factors that often differed by subgroups within a population, as well as for a region or a country. Unfortunately, although most studies report that they conducted formative research, only about half of the studies presented sufficient detail to allow others to benefit from their methods, findings or application.

Second, effective studies delineated the programme impact pathway to the target behaviour change and assessed intermediary behaviour changes to learn what worked. This process created a road map for intervention development, analysis and improvements. However, in the majority of studies, the use of a pathway analysis was implicit rather than explicit. It could be inferred from the description but was not systematically presented. To develop a stronger theoretical foundation for BCI, a more explicit presentation of the pathway analysis would provide a basis for comparative analysis to identify commonalities and variations in the key components and to facilitate effective scale up and dissemination.

We found that BCIs that used these developmental and implementation processes were effective despite heterogeneous design components and approaches. However, there may have been bias towards positive results from publication bias and from the majority of studies only assessing data immediately post-intervention. The overall study heterogeneity made

it difficult to draw additional conclusions about the impact of key intervention design components (e.g. length and intensity or platform) as none of the reviewed studies compared alternative components. Importantly, the intervention studies utilised only one method of behaviour change, most frequently a form of knowledge transfer, and did not compare the impact or cost-effectiveness of alternative approaches.

We found only limited evidence for cost or cost-effectiveness, sustainability or scalability. Of the three studies that provided cost data, only one provided DALY data and none benchmarked results versus the World Bank's projected BCI cost per beneficiary of US\$7.50 (Horton *et al.* 2010). Many studies aimed to test integration of the interventions with the health system as a sustainability strategy, whether directly or by using health workers in a community-based approach, but the studies reported mixed behaviour and growth outcomes. Positive Deviance interventions demonstrated sustained behaviour change, but were initially resource intensive. Interventions that extended existing programmes or leveraged the health system were also potentially scalable, but these were not tested at scale. In addition, there was limited discussion of scalability in the preponderance of studies that used a community-based platform. The few studies that used social marketing interventions are promising in that they reached larger populations through media and demonstrated sustained behaviour change; however, they required continued marketing investments as well as population bases that could respond.

Our analysis was limited by the lack of published detail on *how* design and implementation were carried out. Few studies delved into the 'black box' to report how the formative research identified barriers and enablers to feeding practices, how these data were used to develop the strategy and messages or why the intervention led to the intermediary behavioural changes throughout the programme impact pathway. This also inhibited our ability to systematically evaluate the effectiveness of design components and overall approaches in comparison with others. Finally, the lack of studies reporting data on cost-effectiveness, sustainability and scalability limited our ability to discuss these issues. The gray literature may

have included more design and implementation detail, but we limited our study to peer-reviewed interventions to ensure a consistent level of rigorous analysis and reported outcomes.

To drive the development of sustainable, scalable and cost-effective interventions, we recommend a more strategic research agenda that will allow the global behaviour change community to understand which determinants are the most impactful and which ones are important for a sustainable, scalable and cost-effective intervention. The initial step should be to request more comprehensive reporting. We suggest, in Table 2, 11 areas to be included in future publications of BCI studies that will accelerate the development of a database of evidence on the determinants of effective BCI. The intent of this recommendation is consistent with the TREND statement reporting for non-randomised designs (Des Jarlais *et al.* 2004). It also models the work done in human immunodeficiency virus prevention that measured components of sound programmes and developed a list of best practices and a tool to measure them (Kirby *et al.* 2007; Kirby & Laris 2009). We realise that the lack of published study detail may be due to external constraints, particularly publishing space limits or project funding constraints; however, creative solutions must be found to enable more systematic behaviour change research evidence to accumulate.

Table 2. Suggested reporting requirements for behaviour change interventions

1. How was the formative research conducted?
2. What were the key insights from the formative research?
3. How was the formative research used to develop the strategic approach, construct the key messages and chose communication channels?
4. What were the specific key messages?
5. Provide examples of the communication materials (handouts, flipcharts, media, etc.).
6. Provide details of intervention implementation (number and intensity of sessions, attendance, facilitator training and ongoing fidelity, instruction methods).
7. What are the insights into the outcomes of the study, along the hypothesised pathway for impact?
8. Is there evidence for the intervention's impact compared with other evidence-based interventions?
9. What are the data on cost-effectiveness?
10. What is the evidence for scalability?
11. Is there evidence about sustainability?

In addition, we recommend studies to compare determinants of intervention approaches and components, beyond pilot or programme evaluations. Studies should compare scalable methods of behaviour change, such as behavioural economics, social marketing, and health systems change, and alternative intensity, length and platforms. The recommended framework of comprehensive intervention data will support this research; however, new funding sources may be required for these comparative studies.

Conclusion

It is clear that BCI have an important role in improving feeding and care practices, and in turn, in improving growth and preventing stunting. As a community of practitioners, programme planners and investigators, we do not know enough about what makes these interventions work, for whom, when, why, at what cost and for how long. We hope that this analysis will serve as a catalyst for more detailed and more systematic descriptions of the critical success factors in complementary feeding behaviour change and the fielding of intervention studies that compare determinants of intervention approaches and components. A more strategic research agenda will contribute to the global evidence base that will enable the scaling up of impactful, cost-effective and sustainable behaviour change.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Contributions

CF, MVL, and GP conceptualized the article; CF led the review and the writing; MVL and GP drafted sections of the manuscript; and all authors read, edited and approved the final manuscript. The manuscript is original, has not been previously published and is not being considered for publication elsewhere.

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