Systematic Review of Complementary Feeding Strategies amongst Children Less than Two Years of Age

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Report from the Maximising the Quality of Scaling up Nutrition Programmes (MQSUN)

About Maximising the Quality of Scaling up Nutrition Programmes (MQSUN)

MQSUN aims to provide the Department for International Development (DFID) with technical services to improve the quality of nutrition-specific and nutrition-sensitive programmes. The project is resourced by a consortium of eight leading non-state organisations working on nutrition. The consortium is led by Program for Appropriate Technology in Health (PATH).

The group is committed to:

- Expanding the evidence base on the causes of undernutrition.
- Enhancing skills and capacity to support scaling up of nutrition-specific and nutrition-sensitive programmes.
- Providing the best guidance available to support programme design, implementation, monitoring, and evaluation.
- Increasing innovation in nutrition programmes.
- Knowledge-sharing to ensure lessons are learnt across DFID and beyond.

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Contents

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Acronyms

BF	Breastfeeding
BMI	Body Mass Index
CI	Confidence Interval
Cm	Centimetres
DFID	Department for International Development
EPOC	Effective Practise, Organisation, and Communication
GIV	Generic Inverse Variance
HAZ	Height-for-Age
IUGR	Intra Uterine Growth Retardation
Kg	Kilograms
LMIC	Low- and Middle-Income Countries
MD	Mean Difference
MFGM	Milkfat Globule Membrane
MUAC	Mid-Upper-Arm Circumference
NCHS	National Center for Health Statistics
QPM	Quality Protein Maize
RCT	Randomised Controlled Trials
RR	Risk Ratio
RUTF	Ready-to-Use Therapeutic Food
SD	Standard Deviation
SMD	Standard Mean Difference
WAZ	Weight-for-Age
WFP	World Food Programme
WHO	World Health Organization
WHZ	Weight-for-Height
WMD	Weighted Mean Difference

Executive Summary

The prevalence of malnutrition in low- and middle-income countries (LMICs) is considerably high. Malnutrition leads to susceptibility to preventable infectious diseases and has an indirect association with the leading causes of death in children. According to an estimate, 19.4% of children less than five years of age in these countries were underweight (weight-for-age [WAZ] Z score <-2) and about 29.9% were stunted in the year 2011 (height-for-age [HAZ] Z score <-2). Malnutrition is preventable through effective complementary feeding practices. Several strategies have been employed to improve complementary feeding practices. These include nutritional education to mothers designed to promote healthy feeding practices; provision of complementary food offering extra energy (with or without micronutrient fortification); and increasing energy density of complementary foods through simple technology.

In this review, we have included randomised controlled trials (RCTs) and non-RCTs that assessed the impact of complementary feeding and education on complementary feeding on linear growth, weight gain, iron status, and morbidity. Broadly, interventions were classified as education on complementary feeding and complementary feeding with or without nutrition education. We have also mentioned the costs of the interventions given in the included studies and other complementary foods available globally.

All available papers/reports on the effect of complementary feeding (fortified or unfortified, but not micronutrients alone) and education on complementary feeding on children less than two years of age in Low and middle income countries (LMIC) were included. Studies that delivered intervention and assessed outcome for at least six months were included. We excluded all those studies in which intervention was given for supplementary and therapeutic purposes and those that assessed the impact of micronutrients alone.

We included 11 randomised controlled trials (RCTs) and 7 non-RCTs. We conducted meta-analysis on RCTs. Amongst all RCTs, eight were on nutritional education only. We found significant impact of nutritional education on linear growth (height-for-age Z scores: SMD 0.22; 95% Confidence Interval [CI]: 0.08, 0.37, n=1,486, 4 studies; stunting: risk ratio (RR) 0.72; 95% CI: 0.57, 0.93, n=1445, 2 studies) and weight (weight-for-age [WAZ] Z scores: SMD 0.20; 95% CI: 0.07, 0.33, n=1673, 4 studies). On the other hand, we found four trials in which children were provided with complementary feeding with or without nutrition education. We found that complementary feeding with or without education had a non-significant impact on HAZ scores (SMD 0.46; 95% CI: -0.24, 1.17, 4 studies, n=500), and WAZ (SMD 0.15; 95% CI: -0.09, 0.40, 2 studies, n=262).We also performed a meta-analysis based on the type of food, but we are unable to conclude which types of foods are the most effective in preventing undernutrition because the numbers of studies in each subtype were few.

We found that these interventions had a significant impact on reducing the prevalence of respiratory illness (RR 0.68; 95% CI: 0.48, 0.97, 2 studies, n=629). However, there was no difference in fever and diarrhoea episodes.

We also attempted to gather data on cost of the interventions, food products, and complementary feeding strategies used in the included studies. Most papers did not mention estimates of cost and thus, we contacted the authors with the request to provide us with cost data. We have also included cost estimates of various complementary foods that were not used in any of the interventions included in

this review but can potentially have an impact in reducing undernutrition. The cost of different baby food products, including cereals, porridge, and biscuits produced by different manufacturers were identified via web search.

The scarcity of available studies and their heterogeneity as well as the variety in complementary feeding interventions make it difficult to determine one particular type of complementary feeding intervention as the most effective. Nonetheless, the results of this review indicate that effectively implemented provision of complementary feeding and education on complementary feeding have a potential to prevent undernutrition in children. Our review also found that nutritional education and complementary feeding (either individually or combined) both have the potential to reduce morbidity from respiratory infections. However, further high-quality studies need to be conducted which report consistent outcome measures and similar interventions in order to accurately map out which interventions, if scaled up, can be effective. Moreover, these trials should consider using standardised types of food in the intervention so that evidence can be formulated on which type of food is most effective. It is ideal to keep the duration of intervention for at least six months since anthropometric improvements are gradual. Trials should report consistent outcomes and also include morbidity outcomes. Despite clear evidence of the disastrous consequences of childhood nutritional deprivation in the short and long terms, nutritional health remains a low priority. Therefore, enhanced and rigorous actions are needed to deliver and scale up nutritional education and complementary feeding interventions.

Introduction

About one-third of deaths in children under five years of age are due to underlying undernutrition, which includes stunting, severe wasting, deficiencies of vitamin A and zinc, and suboptimum breastfeeding (BF).[1] Childhood malnutrition is prevalent LMICs. According to an estimate, 19.4% of children less than five years of age in these countries were underweight (WAZ Z score <-2) and about 29.9% were stunted in the year 2011 (height-for-age Z score <-2).[2] The prevalence of both underweight and stunting was highest in Africa and South-Central Asia, and stunting and wasting, along with intrauterine growth restriction (IUGR,) are responsible for about 2.1 million deaths worldwide in children less than five years of age.[3] It is well-recognised that the period of 6 to 24 months of age is one of the most critical time periods in the growth of the infant. The incidence of stunting is the highest in this period, as children have high demand for nutrients and there are limitations in the quality and quantity of available foods, especially after exclusive BF.[1, 4]

Importance of complementary feeding

Complementary feeding for infants refers to the timely introduction of safe and nutritional foods in addition to breast-feeding (BF) (i.e., clean and nutritionally rich additional foods introduced at about six months of age).[5] These foods are typically provided to children from 6 to 24 months of age.[6] It has been suggested that in addition to disease-prevention strategies, complementary feeding interventions targeting this 'critical window' are most efficient in reducing malnutrition and promoting adequate growth and development.[7] According to the World Health Organization (WHO), complementary feeding should be timely, adequate, appropriate, and given in sufficient quantity.[6] Several strategies have been employed to improve complementary feeding practices.[1] These include nutritional education to mothers designed to promote healthy feeding practices; provision of complementary foods offering extra energy (with or without micronutrient fortification); and increasing energy density of complementary foods through simple technology.[1, 8]

Evidence from previous reviews

Over the last five years, four reviews have been published on the impact of various complementary feeding interventions.[1, 5, 9, 10] Squassero 2012[10] is the most recently published review on the subject. It evaluated the effectiveness of the provision of supplementary feeding for children under the age of five in LMICs. It included only studies that used supplementary feeding interventions defined as the provision of extra food to children or families beyond the normal ration of their home diets. A meta-analysis by Batool et al. for Bhutta Lancet 2008[9] evaluated the impact of complementary feeding strategies on linear growth, particularly HAZ (mean Z scores). They classified the included studies as 'food secure' or 'food insecure', depending on the average per capita income.

Imdad 2011,[5] on the other hand, reviewed the impact of maternal education on complementary feeding with or with provision of complementary feeding. The outcomes reported were weight and height increase, but the review also included studies on malnourished children and studies that provided interventions for smaller periods of duration (i.e., less than six months). However, Dewey 2008[1] performed a systematic review that included trials with educational interventions, provision of complementary feeding, and complementary feeding plus education. The review also included studies in

which micronutrients were given alone (without food). They grouped studies and presented findings based on the scale of intervention (i.e., efficacy/effectiveness). No formal meta-analysis was performed due to the high heterogeneity in the components of the interventions. Hence, only a rough estimate of effect size was given by averaging across interventions.

We, in this review, have attempted to pool effect sizes from studies based on their scale of intervention (efficacy/effectiveness) and type of food provided, and we have considered the food security of the defined population. However, we have excluded all those studies in which micronutrient(s) were given alone without complementary foods, and in which complementary food was given for therapeutic purposes to malnourished children. We have also attempted to report data on the cost of different complementary food interventions and products available. Thus, our review will further add to the knowledge on this topic by attempting the pooled analyses based on different contextual factors.

The review by Dewey and Adu-Afarwuah 2008,[1] which was an update of a previously published review (Caulfield et al. 1999),[8] was largely qualitative in nature, and little effort was undertaken to pool impact estimates. This review on six efficacy trials and five effectiveness studies in which the main intervention was education on complementary feeding found a modest effect on weight (mean effect size = 0.28; range -0.06, 0.96) and linear growth (mean effect size 0.20, range 0.04, 0.64). The review of seven efficacy trials indicated that provision of complementary feeding can have a significant impact on growth (weight 0.26; range -0.02, 0.57 and height 0.28; range -0.04, 0.69). Two efficacy and six effectiveness trials on the effect of the food combined with maternal education found a significant impact on weight 0.35 (range 0.18, 0.66) and linear growth 0.17 (range 0, 0.32).

The meta-analyses by Batool et al. for Bhutta 2008 Lancet Under-nutrition Series[9] reported significant impact of provision of complementary feeding (with or without education) on HAZ Z score (weighted mean difference [WMD] 0·41 (95% CI: 0.05, 0.76) for food-insecure populations. The review also reported the significant impact of education on complementary feeding on HAZ Z score (WMD 0.25; 95% CI: 0.01, 0.49) for food-secure populations.

As previously mentioned, a review by Imdad 2011[5] demonstrated that both provision of appropriate complementary foods (with or without nutritional counselling) and nutritional counselling alone resulted in significant increase in weight (WMD 0.34 95% CI: 0.11, 0.56 and WMD 0.30, 95% CI: 0.05, 0.54 respectively) and linear growth (WMD 0.26, 95% CI: 0.08, 0.43 and WMD 0.21 95% CI: 0.01, 0.41 respectively).

A recent Cochrane review by Squassero 2012[10] looked at the impact of the provision of extra food to children or families beyond the normal rations of their home diets. The review found a significant difference in length in children less than 12 years of age (mean difference [MD] 0.19 centimetres (cm); 95% CI: 0.07, 0.31).

Why it is important to do this review

Previous reviews were largely qualitative in nature, and little effort was undertaken to develop robust meta-analysis based on impact estimates. We performed meta-analysis with studies pooled as type of complementary food; scale of trial (i.e., efficacy/effectiveness and according to food security of the given populations). We assessed the impact of two complementary feeding strategies—nutritional education on complementary feeding and provision of complementary food with or without nutritional

education on child growth. We also determined the impact of these two strategies on childhood morbidities, including diarrhoea, respiratory infections, and fever. We further gathered data on the cost of delivery of intervention and the cost of different food products available in the market.

Objectives

The specific objectives of this systematic review are to:

- Collate and synthesise relevant information on the roles of complementary feeding and education on complementary feeding in children 6 to 24 months of age.
  - Identify interventions and their effectiveness on growth, iron status, and morbidity.
  - Undertake cost analysis of intervention and food products.
- Based on the above, we will develop an analytical summary of current evidence of intervention impact and draft recommendations.

Methods

Criteria for considering studies for this review

Types of studies

A comprehensive search of studies was performed from several data sources, without language restrictions (in the case of non-English papers, efforts were made to translate the text into English). We considered all available published and unpublished papers/reports on the impact of complementary feeding interventions for children less than two years of age. Our priority was to select RCTs conducted in LMICs to generate the evidence of interventions. However, we also included non-RCTs and longitudinal studies with comparison groups (in which people/clusters are allocated to different interventions using methods that are not random) that provided outcomes observations at multiple time points using Campbell methods and Cochrane effective practice, organisation, and communication group (EPOC).[11, 12]

Inclusion criteria

1. All available papers/reports on the effect of complementary feeding and education on complementary feeding (fortified or unfortified, but not micronutrients alone).
2. Included children less than two years of age.
3. Conducted in LMICs.
4. Studies that provided intervention for at least six months and more.

Exclusion criteria

1. Studies where the target group was deliberately selected to be acutely malnourished (stunted or wasted), and where the products were being tested for the purpose of treatment.
2. Studies in which the selected group was provided with supplementary foods rather than complementary foods
3. Studies that assessed the impact of micronutrients alone (where both the groups were given complementary feeding).

Search methods for identification of studies

Electronic searches

The following sources of information were used to search literature for review:

1. All available electronic reference libraries of indexed medical journals and analytical reviews.
2. Electronic reference libraries of non-indexed medical journals.
3. Non-indexed journals not available in electronic libraries.
4. Pertinent books, monographs, and theses identified through electronic or hand searching.
5. Project documents and reports.

We searched PubMed, Google, and Alltheweb, as well as the official websites of various private voluntary organisations for non-peer reviewed papers and programme reports not listed in PubMed. We also searched trial registers and by contacting key researchers in this area and inquiring whether there are any trials or systematic reviews planned on this topic. We used the same search strategy defined by Dewey 2008[1] with slight modification in the dates used (2006 previously; we changed it to 2012) :(((randomised controlled trial [pt] OR controlled clinical trial [pt] OR randomised controlled trials [mh] OR random allocation [mh] OR double-blind method [mh] OR single-blind method [mh] OR clinical trial [pt] OR clinical trials[mh] OR ('clinical trails' [tw]) OR ((sing* [tw] OR doubl* [tw] OR trebl* [tw] OR tripl* [tw]) AND (mask* [tw] OR blind*[tw])) OR ('latin square' [tw]) OR placebos [mh] OR placebo* [tw] OR random* [tw] OR research design [mh:noexp] OR comparative study [mh] OR evaluation studies [mh] OR follow-up studies [mh] OR prospective studies [mh] OR cross-over studies [mh] OR control* [tw] OR prospective* [tw] OR volunteer* [tw]) NOT (animal [mh] NOT human [mh]) AND (Clinical Trial [ptyp] OR Randomised Controlled Trial [ptyp] OR Classical Article [ptyp] OR Clinical Trial, Phase I [ptyp] OR Clinical Trial, Phase III [ptyp] OR Clinical Trial, Phase IV [ptyp] OR Controlled Clinical Trial [ptyp] OR Journal Article [ptyp]) AND (English [lang] OR Spanish [lang]) AND (infant [MeSH:noexp]) AND ((weaning food* [tw] OR weaning food* [mh] OR complementary food* [tw] OR complementary food* [mh] OR complementary feed* [tw] OR complementary feed* [mh]) OR home fortification [tw]AND (Clinical Trial [ptyp] OR Randomised Controlled Trial [ptyp] OR Classical Article [ptyp] OR Clinical Trial, Phase I [ptyp] OR Clinical Trial, Phase III [ptyp] OR Clinical Trial, Phase IV [ptyp] OR Controlled Clinical Trial [ptyp] OR Journal Article [ptyp]) AND (English [lang] OR Spanish [lang]) AND (infant [MeSH:noexp]) NOT (retracted publication [pt]).

Types of outcomes

Primary outcome:

- Linear growth amongst children aged 6 to 24 months (height, HAZ, prevalence of stunting).

Secondary outcomes:

- Weight gain amongst children aged 6 to 24 months.
- Weight gain and linear growth of children aged 24 to 59 months (weight, WAZ, WHZ, prevalence of wasting, and underweight).
- Other anthropometric measurements (mean upper-arm circumference [MUAC], body mass index [BMI]).
- Iron status (haemoglobin, ferritin, prevalence of anaemia).
- Morbidity amongst children (diarrhoea, respiratory infections, fever).
- Cost of delivery of intervention and cost of food product.

Data collection and analysis

Trial eligibility and screening of all available titles and abstracts for inclusion were assessed by two review authors independently. If we were unable to learn relevance by screening the title and abstract, we retrieved and went through the full text of the article. Two review authors retrieved full texts of relevant articles and independently judged eligibility by filling out forms designed in accordance with the specified inclusion criteria. We resolved any differences by discussion or, if required, conferred with a third review author. Excluded studies are tabulated in 'characteristics of excluded studies' (**Table 11**) along with their reasons for exclusion.

Quantitative data synthesis

We broadly classified the studies based on the intervention strategies used as nutrition education on complementary feeding and complementary feeding with or without nutrition education. Studies that had complementary feeding combined with nutritional education and those that had only complementary feeding as the intervention were merged and analysed together. The basis for this merging was that complementary feeding interventions are always attached with briefing and instructions on how to prepare or use the complementary food, even if nutritional education is not a specific component of the intervention. We synthesised findings based on scale of trial, food security of the given population, and type of food product used.

Data analysis

We performed statistical analysis of RCTs using the Review Manager software. Data analyses of the outcomes were based on an intention-to-treat principle. For dichotomous data, we presented results as summary RR with 95% CIs. For continuous data, we used the standard mean difference (SMD) between trials if outcomes were measured comparably. We first pooled the data to get a standardised WMD, also known as 'standard mean difference' (SMD), or 'effect size'. The advantage of calculating WMD is that it eliminates the problems of units of measurement and duration, which may vary across studies.[13] In order to pool cluster randomised or individually randomised trials together, we converted them all in log RR and pooled them using generic inverse variance (GIV). We have also converted HAZ Z scores into rates of stunting after considering the standard deviation (SD) of 1.4 for stunting in this population.[9] The forest plots included in this review are based on pooling evidence from RCTs only. However, most of the previous reviews[5, 9] have also meta-analysed RCTs with non-randomised controlled studies. Therefore, we have separately pooled RCTs with non-RCTs together using Campbell methods and EPOC methods[11, 12] and presented them in the **Web Annex**.

Dealing with missing data and heterogeneity

The level of attrition was noted for each study. Heterogeneity between trials was assessed using the I^2 statistic, P value of <0.1 (on chi^2) and by visual inspection of forest plots. When high levels of heterogeneity between trials (exceeding 50% with P value <0.1) were identified, further exploration was conducted by subgroup analysis. We performed subgroup analyses based on single study as well to show how specific intervention was different in particular studies. We initially undertook fixed-effects meta-analysis for combining data where trials examined the same intervention, but then repeated the analysis and applied random-effects meta-analysis as an overall summary when substantial methodological heterogeneity between and amongst the studies was found. We also report P value of interaction tests.

Subgroup analysis

We performed the following subgroup analysis:

- Efficacy versus effectiveness trials: Interventions were considered efficacy trials if there was a high degree of assurance of delivery of the 'treatment', generally under carefully controlled research conditions (e.g., provision of a fortified complementary food with frequent follow-up to assess adherence). Evaluations of interventions carried out in a programme setting, generally with less ability to control delivery of and adherence to 'treatment', were considered effectiveness studies.[1] The majority of the studies included in this review provided this information.
- Type of complementary food.
- Studies in populations with an average per-capita income under USD 1.25 were classified as "food insecure," whilst studies in populations with a higher income were classified as "food secure."

Data extraction and management

Double data abstraction was performed on included studies using standardised extraction forms. The comparison of the extracted data enabled us to correct errors.

Assessment of risk of bias in included studies

The methodological quality of RCTs was measured using the Cochrane methods of risk of bias assessment[14] described in **Table 1** below. However, for non-RCTs, we used EPOC methods for risk of bias assessment.[12]

Table 1: Assessment of Risk of Bias

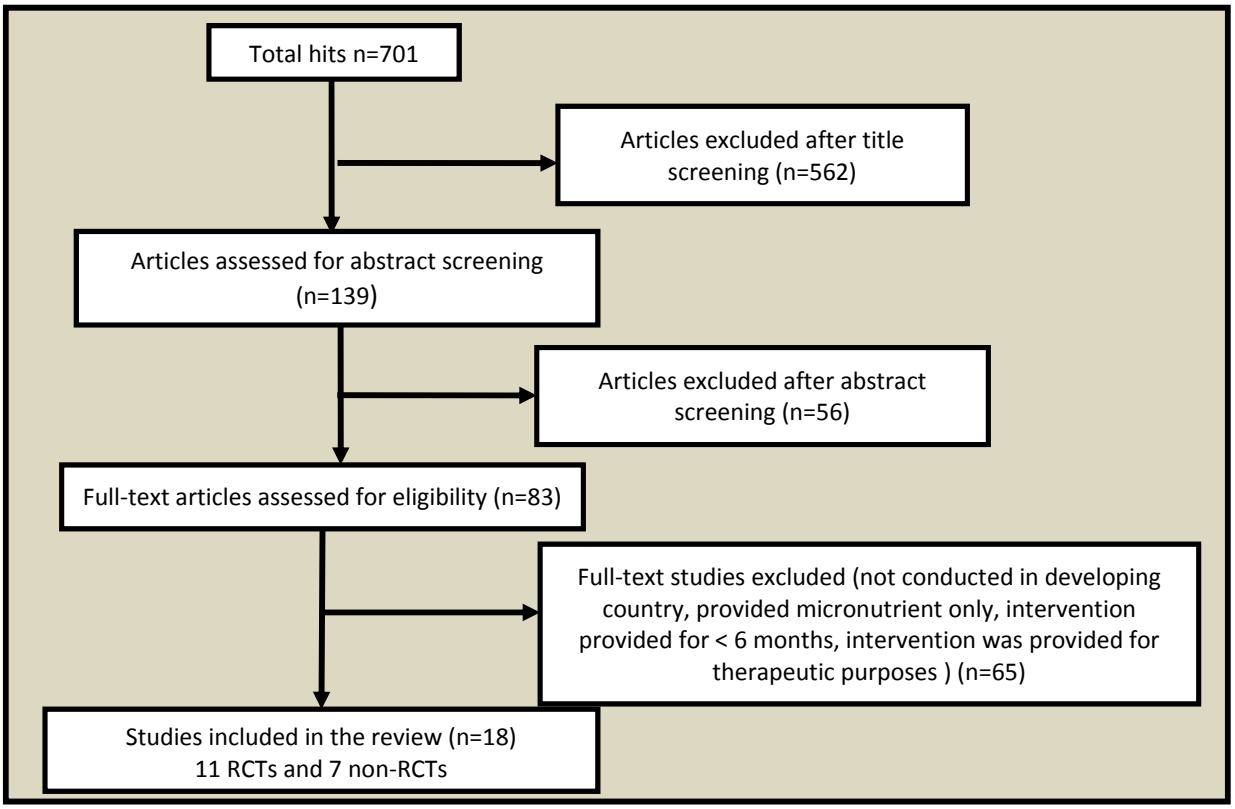
Sequence Generation	Allocation Concealment	Blinding	Incomplete Outcome Data	Selective Reporting Bias
Low risk (any truly random process, e.g., random number table; computer random-number generator)	Low risk (e.g., telephone or central randomisation; consecutively numbered sealed opaque envelopes)	Low risk, high risk, or unclear for participants	Low risk	Adequate (where it is clear that all of the study's pre-specified outcomes and all expected outcomes of interest to the review have been reported)
High risk (any non-random process, e.g., odd or even date of birth; hospital or clinic record number)	High risk (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth)	Adequate, high risk, or unclear for personnel	High risk	Inadequate (where not all the study's pre-specified outcomes have been reported; one or more reported primary outcomes were not pre-specified; outcomes of interest are reported incompletely and so cannot be used; study fails to include results of a key outcome that would have been expected to have been reported)
Unclear	Unclear	Low risk, high risk, or unclear for outcome assessors	Unclear	Unclear

Results

We identified 701 titles from different sources. Following abstract screening of the identified titles, 139 studies met the criteria for which full-text articles were retrieved for assessment. Amongst these, 18 met the final eligibility criteria. Of these 18, 11 were RCTs and 7 were non-RCTs. The last date of search was October 2012 (**Figure 1**). Amongst the RCTs, six were from Asia, two were from Africa, and the remaining three were from different parts of Central and Latin America. Amongst the non-RCTs, three were from Africa, and two each were from Asia and from different parts of America. Anthropometrical and morbidity data on children more than two years of age was not reported separately. A list of excluded studies is mentioned in **Annex II**. We also identified four ongoing trials (**Table 2**).

Characteristics of non-randomised studies are mentioned in **Table 3**. Amongst these, two provided education[15, 16] on complementary feeding and the rest provided complementary feeding with or without education. [17-21]

Figure 1: Flow diagram showing identification of studies



Ongoing studies

We identified four ongoing studies that were relevant to this review (**Table 2**).

Table 2: Characteristics of ongoing studies on nutrition education on complementary feeding or complementary feeding with or without education

Study ID	Country	Type of Study	Title	Intervention	Duration	Status
Tomedi 2012[22] NCT01679535	Kenya	Efficacy	A Nutrition/Hygiene Education Programme for the Prevention of Child Malnutrition	**Infants 1 to 6 Months** Nutrition and hygiene education by community health workers	18 months	Currently recruiting participants
Christian 2012[23] NCT01562379	Bangladesh	Efficacy	Complementary Food Supplements for Reducing Childhood Undernutrition	**Infants 6-8 Months** -Plumpy Doz -Wheat Soy Blend (WSB++) -Chickpea-based complementary food supplement -Rice-based complementary food supplement	12 months	Currently recruiting participants
Cofie 2012[24] NCT01612442	Ghana	Effectiveness	Integrated Education Intervention to Improve Infant and Young Child Nutrition and Growth in Ghana	**Infants 6 to 24 Months** Mothers of children aged 6 to 24 months received monthly nutrition education delivered by community health volunteers and agricultural education delivered by agricultural extension agents, in addition to standard monthly child welfare services delivered by Ghana Health Service	9 months	Study has been completed. Results are forthcoming.
Hambidge 2012[25] NCT00726102	China	Efficacy	Development and Health of Rural Chinese Children Fed Meat as a Daily Complementary Food	**Infants 6 to 18 Months** Provide locally available meat daily	Information not available	Status unknown (as per website)

Table 3: Characteristics of non-randomised controlled studies on nutrition education on complementary feeding or complementary feeding with or without education

Author	Country	Region	Type of Study	Age Group	Intervention- what was the educational message?	Control	Duration of Intervention	Duration of Follow Up	Results
Guldan 2000[15]	China	Rural	Longitudinal with a comparison group Effectiveness Food secure	0 to 12 months/ I: 250 C: 245	Trained nutrition educators provided growth monitoring and counselling in intervention areas. Key messages: a. Bottle feeding may be dangerous b. Frequent suckling on demand is best c. After 4 to 6 months, give daily hard-boiled egg yolk, at first mixed with some breastmilk; thereafter, give thickened rice porridge and other foods d. Baby needs breastmilk for at least a year and needs other foods daily. e. Use home-produced food and the family diets	No intervention	4 to 12 months	12 months	Intervention group: WAZ: -1.17 +- 0.79 HAZ: -1.32+- 1.00 Control: WAZ : 1.93+- 0.79 HAZ: -1.96+- 1.
Kilaru 2005[16]	India	Rural	Longitudinal with a comparison group Efficacy Food insecure	5 to 11 months/ I: 173 C: 69	Use of appropriate local foods and preparation of these foods, appropriate feeding frequency, gradually increasing food diversity, complementary feeding followed by BF, avoidance of feeding bottles	No intervention	12 months	12 months	Intervention group: Weight gain (kg): 0.25+- 0.18 Control: 0.22+-0.18

Table 3: Characteristics of non-randomised controlled studies on nutrition education on complementary feeding or complementary feeding with or without education

Author	Country	Region	Type of Study	Age Group	Intervention- what was the educational message?	Control	Duration of Inter-vention	Duration of Follow Up	Results
Gartner 2007[19]	Senegal	Peri-urban	Repeat cross-sectional study with comparison group Effectiveness Food secure	6 to 35 months (under-weight or nutrition-ally at risk children) I: 757 C: 917	Children received flour mix from local ingredients; mothers received education (details not specified)	No inter-vention	6 months	6 months	I: % underweight 24 % Stunted 14.7 C: % underweight 22.7 % Stunted 14.5
Lopez de Romana 2000[18]	Peru		Longitudinal with a comparison group Effectiveness Food secure	6 to 23 months	Administration of *Ali Alimentu* (processed CF with the following ingredients: rice, barley, beans, powdered milk, vegetable oil) and nutritional counselling not specified but based on: a. Nutritional needs of children of this age in centres b. Breastfeeding promotion c. Preparation and administration of *Ali Alimentu*	No inter-vention	12 months	12 months	Stunted 56% in intervention and 56% in control
Lutter 2008[21]	Ecuador	Poor com-muniti es	Quasi-RCT Effectiveness Insecure	9 to 14 months	PANN 2000 has 5 major components: 1) information, education, and communication; 2) training of health workers in infant and young child nutrition and counselling skills; 3) community participation; 4) provision of a FCF (Mi Papilla); and 5) monitoring and evaluation Mi Papilla consists of a daily ration of 65 g of dry product that provides 275 kcal/d (1,150.6 kJ/d) and has an energy density of 1.2 kcal/g (5.0 kJ/g) when mixed with the appropriate amount of water.	No inter-vention	12 months	12 months	Weight-for-age Z score 20.62 (60.91) ; 20.88 (61.03) Length-for-age Z score 21.50 (60.99) 21.77 (61.15) SD), % 0.6 0.0
Adu-Afarwu ah 2007[17]	Ghana	Not men-tioned	RCT and compared with control arm which was not randomly selected Efficacy Food insecure	5 months/ I: 97 C: 81	Nutributter: fortified fat spread modified to include a still larger set of micronutrients plus added energy. (RNI of 14 vitamins and minerals plus some calcium, potassium, phosphorous, magnesium, and manganese as well as energy (108 kcal/g).	No inter-vention	6 months	6 months	Intervention grp: WAZ -0.40+-1.10 HAZ: -0.14+-1.00 Hb: 114+-14 % Anaemia: 10 Control: WAZ: -0.74+-1.10 HAZ -0.40+-1.00 Hb 106+-14 % Anaemia 32
Lartey 1999 [20]	Ghana	Not men-tioned	RCT where no intervention arm was cross-sectional in which children who	6 to 12 months I 216 C: 464	Weanimix (W), Weanimix plus vitamins and minerals (WM), Weanimix plus fish powder (WF), and koko plus fish powder (KF). KF was compared with control group with no intervention.	No inter-vention	12 months	12 months	-1.19 0.93 -1.71 0.9 ES: 0.57 (WAZ) 0.63 0.84 1.27 1.02 ES: 0.69 (LAZ)

Table 3: Characteristics of non-randomised controlled studies on nutrition education on complementary feeding or complementary feeding with or without education									
Author	**Country**	**Region**	**Type of Study**	**Age Group**	**Intervention- what was the educational message?**	**Control**	**Duration of Inter-vention**	**Duration of Follow Up**	**Results**
			were not selected were measured. Efficacy Insecure						

Quality of the evidence

In general, the risk of bias assessment of all RCTs suggested a low to moderate level of quality. There was unclear or missing information regarding sequence generation, allocation concealment, blinding, and handling of exclusions after allocation to interventions in several papers (**Figures 2 and 3a**). However, risk of bias assessment of non-RCTs suggested poor quality, and most of the information for assessment was not given at all (**Figure 3b)**

Figure 2: Risk of bias summary of RCTs

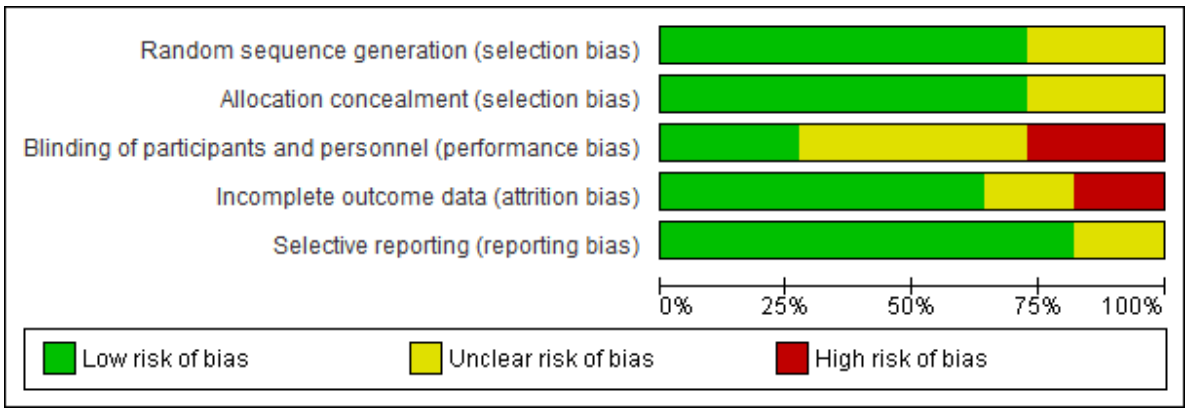


Figure 3a: Risk of bias summary of RCTs

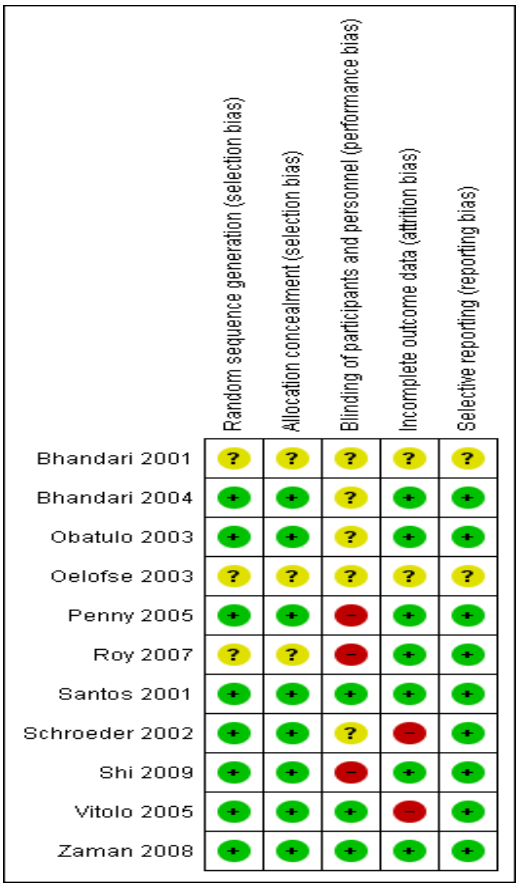
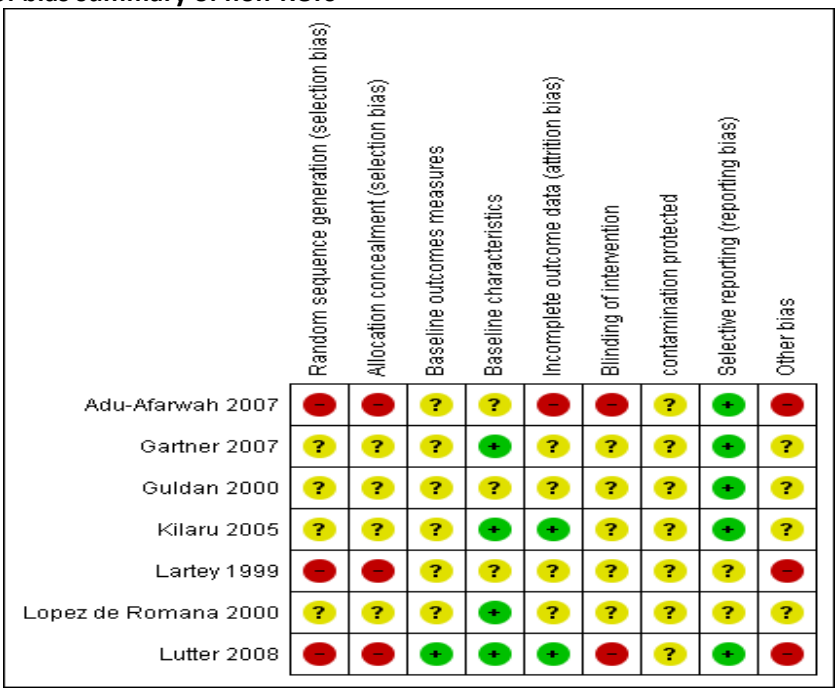


Figure 3b: Risk of bias summary of non-RCTs



Educational interventions

There were seven studies including 3,733 children at baseline in which the intervention group received education on complementary feeding only.[26-33] Amongst these, five were efficacy trials,[26, 27, 30, 32, 33] whereas three were effectiveness trials/programmes.[28, 29, 31] Five were the studies from food-secure populations,[28, 30-33] whereas three were from food-insecure populations.[26, 27, 29] We have provided details of the educational interventions described in each study using the criteria reported by Ashworth and Ferguson 2009[40] (**Table 6**). Additionally, forest plots illustrating the results of the pooled analysis are given in **Annex I**.

Effect on linear growth

Height gain

Pooled analysis showed that nutritional education alone did not improve height gain (cm) (SMD 0.14; 95% CI: -0.05, 0.34, random model, n=2,242, five studies, tau^2= 0.04, I^2=79%, Chi^2 P value 0.0007) (Annex 1.1). Based on scale of trials, effectiveness trials showed significant improvement of height gain (SMD 0.36; 95% CI: 0.08, 0.65, n=814, two studies, tau^2= 0.03, I^2=76%, Chi^2 P value 0.04) (Annex 1.1.1). The test of interaction found a significant difference in estimates based on scale of trial (P=0.03). No significant differences in height gain were observed on food security (Annex 1.1.2).

Height-for-age (Z scores)

Pooled analysis showed that nutritional education alone had a significant impact on improving HAZ (SMD: 0.23; 95% CI: 0.08, 0.37, random model, n=1,486, four studies, tau^2= 0.01, I^2=46%, Chi^2 P value 0.14) (Annex 1.2). The test of interaction found a significant difference in impact estimates based on scale of trial (P=0.05), and results were significant for effectiveness trials (SMD: 0.30; 95% CI: 0.17, 0.43, random model, n=949, two studies, tau^2= 0.00, I^2=0%, Chi^2 P value 0.38) (Annex 1.2.1). All, except Roy 2007,[39] were from food-secure populations. Roy et al.[39] displayed a significant impact on HAZ (SMD 0.25; 95% CI: 0.09, 0.42) (Annex 1.2.2).

Table 4: Summary estimates from studies on nutrition education on complementary feeding: Impact differences by scale

Outcome	Efficacy (estimate)	Number of studies	Effectiveness	Number of studies
Height gain (cm)	SMD: 0.02 (95% CI: -0.08, 0.13)	3	**SMD 0.36 (95% CI: 0.08, 0.65)**	2
HAZ (Mean Z scores)	SMD 0.09 (95% CI: -0.08, 0.26)	2	**SMD 0.30 (95% CI: 0.17, 0.43)**	2
Stunting (HAZ <-2)	OR 0.82 (95% CI: 0.60, 1.11)	2	OR 0.55 (95% CI: 0.29, 1.04)	2
Weight gain (kg)	SMD 0.02 (95% CI: -0.08, 0.13)	3	**SMD 0.27 (95% CI: 0.14, 0.41)**	2
WAZ (Mean Z score)	SMD 0.08 (95% CI: -0.06, 0.23)	2	**SMD 0.30 (95% CI: 0.18, 0.43)**	2
Underweight (WAZ <-2)	RR 1.03 (95% CI: 0.90, 1.18)	1	-	-
WHZ (Z Score)	SMD 0.26 (95% CI: -0.14, 0.66)	2	SMD 0.14 (95% CI: 0.02, 0.27)	2

Stunting

Pooled analysis showed that nutritional education alone had a significant impact on improving the rates of stunting (OR: 0.72; 95% CI: 0.57, 0.93, random model, n=1,445 studies, tau^2= 0.04, I^2=83%, Chi^2 P value 0.0006) (Annex 1.3). Based on scale of trials, education on CF alone had insignificant impacts on rates of stunting and test of interaction was non-significant (P=0.28) (Annex 1.3.1). All, except Roy 2007,[39] were from food-secure populations. Roy et al.[39] displayed a significant impact on stunting (OR 0.68; 95% CI: 0.60, 0.76) (Annex 1.3.2).

Effect on weight

Weight gain

Pooled analysis showed that nutritional education alone had a non-significant impact on weight gain (kg) (SMD 0.12; 95% CI: -0.02, 0.26, random model, n=2,242, five studies, tau^2= 0.01, I^2=61%, Chi^2 P value 0.04) (Annex 1.4). Based on scale of trial, effectiveness studies showed significant improvement in weight gain (SMD 0.27; 95% CI: 0.14, 0.41, two studies, n=814, tau^2= 0.00, I^2=0%, Chi^2 P value 0.32). Test of interaction found difference in results based on scale of trials (P 0.004) (Annex 1.4.1). Based on the food security, food-secure populations displayed a significant impact on weight gain (SMD 0.21; 95% CI: 0.07, 0.36, three studies, n=1,219 tau^2= 0.01, I^2=39%, Chi^2 P value 0.20) (Annex 1.4.2).

Weight-for-age (Z score)

Pooled estimates showed significant improvements in WAZ (SMD 0.20; 95% CI: 0.07, 0.33, random effects, four studies, n=1,673, tau^2= 0.01, I^2=43%, Chi^2 P value 0.16) (Analysis 1.5). The test of interaction found a significant difference in impact estimates based on scale of trial (P=0.02) and results were significant for effectiveness trials (SMD: 0.30; 95% CI: 0.18, 0.43, random model, n=949, four studies, tau^2= 0.00, I^2=0%, Chi^2 P value 0.75) (Annex 1.5.1). All studies were from food-secure populations, except Roy 2007,[39] which showed a significant impact on WAZ (SMD 0.20; 95% CI: 0.07, 0.33) (Annex 1.5.2).

Underweight

We found one efficacy trial from food-insecure populations that showed non-significant impact for underweight (RR 1.03; 95% CI: 0.90, 1.18, random model, n=829, one study) (Annex 1.6).

Effect on other anthropometric measurements

Weight-for-height Z scores

The pooled analysis showed a significant impact on weight-for-height Z scores (WHZ) (SMD 0.20; 95% CI: 0.03, 0.36, random model, n=1,566, four studies, tau^2= 0.02, I^2=64%, Chi^2 p value 0.04) (Annex 1.7). Based on scale of trials, effectiveness had a significant impact on WHZ (SMD 0.14, 95% CI: 0.02, 0.27, two studies, n=949, tau^2= 0.00, I^2=0%, Chi^2 P value 0.09) (Annex 1.7.1). However, test of interaction was insignificant (P=0.54). All studies were from food-secure populations, except Roy 2007,[39] which displayed a non-significant impact (Annex 1.7.2).

Table 5: Summary estimates from studies on nutrition education on complementary feeding: impact estimates (as food secure/insecure populations)

Outcome	Food-secure populations(estimates)	Number of studies	Food-insecure populations (estimates)	Number of studies
Height gain (cm)	SMD 0.25 (95% CI: -0.01, 0.52)	3	SMD 0.00 (95% CI: -0.15, 0.16)	2
HAZ (Mean Z scores)	SMD 0.21 (95% CI: -0.01, 0.44)	3	**SMD 0.25 (95% CI: 0.09, 0.42)**	1
Stunting (HAZ <-2)	OR 0.73 (95% CI: 0.50, 1.05)	3	OR 0.68 (95% CI: 0.60, 0.76)	1
Weight gain (kg)	**SMD 0.21 (95% CI: 0.07, 0.36)**	3	SMD -0.00 (95% CI: -0.13, 0.12)	2
WAZ (Mean Z scores)	SMD 0.16 (95% CI: 0.00, 0.33)	3	**SMD 0.29 (95% CI: 0.12, 0.45)**	1
Underweight (WAZ <-2)	-	-	RR 1.03 (95% CI: 0.90, 1.18)	1
WHZ (Z score)	SMD 0.21 (95% CI: -0.03, 0.45)	3	SMD 0.16 (95% CI: -0.00, 0.33)	1

Table 6: Characteristics of included studies on nutrition education on complementary feeding														
Author	**Country**	**Region**	**Type of study**	**Age group/ sample size**	**Intervention- what was the educational message?**	**Control**	**Who delivered?**	**Where was the education given?**	**Duration of intervention**	**Baseline demographics**	**Baseline nutritional status**	**Seasonal variation**	**Duration of follow up**	**Results**
Shi 2009[31]	China	Rural	cRCT Effectiveness Food secure	2-4 mo/ I: 294 C: 305	Educational messages and enhanced home-prepared recipes were disseminated to caregivers through group trainings and home visits. Messages: (i) group training sessions on food selection, preparation and hygiene, childhood nutrition and growth, and responsive feeding style; demonstration of preparing enhanced weaning food recipes, which were formulated using locally available, affordable, acceptable, and nutrient-dense foods such as egg, tomato, beans, meat, chicken, and liver; (iii) booklets which contained infant-feeding guidance and methods of preparing the recommended recipes; and (iv) home visits every three months to identify possible feeding problems and provide individual counselling.	Received a standard package of child health care from the township hospitals which included BF counselling, but did not contain anything other than standard counselling on complementary feeding.	Health care providers	Health facility & home visits	12 months	Infants in the intervention group did not differ significantly from controls. However, more mothers at intervention sites than controls engaged in agriculture work (57.1% vs. 49.8%) and more fathers at intervention sites than controls were migrant labourers who worked temporarily in cities (67.3% v. 55.7%).	At baseline, there were no significant differences in the mean weights and lengths between the intervention and control groups (Weight: 6.51 v. 6.66 kg, P50v09; length: 60.75 v. 61.10 cm, P50v17).	-	8-10 mo	Adjusted difference: weight (kg) gain Mean (95% CI) 0.22 (0.003, 0.45) Length gain (cm) 0.66 (0.03, 1.29).

Author	Country	Region	Type of study	Age group	Intervention- what was the educational message?	Control	Who delivered?	Where was the education given?	Duration of intervention	Baseline demographics	Baseline nutritional status	Seasonal variation	Duration of follow up	Results
Zaman 2008[33]	Pakistan	Urban	RCT Efficacy Food secure	6-24 mo/ I: 151 C: 169	Educational: training health workers in nutrition counselling using the Integrated Management of Childhood Illness (IMCI) module 'Counsel the Mother.'	No intervention	IMCI module—'Counsel the Mother' was used. A local adaptation of Pakistan's IMCI 'feeding counselling card' was developed in the local language.	Community centre	No precise information given. Lady health visitors were trained to deliver education to mothers when they visited health centres. These children were followed up till 180 days.	The socio-economic and demographic characteristics of the two groups were similar.	-	-	180 days	Intervention grp: WAZ 12+ mths: -0.35 +-0.947 HAZ: -0.35+- 0.947 Control: WAZ 0.814+- 1.02 HAZ -0.814+- 1.02
Penny 2005[28]	Peru	Peri-urban	cRCT Effectiveness Food secure	Newborn/ I: 187 C: 190	Health staff received education in counselling and anthropometry; high-performing facilities were accredited. Three key messages: a. Use thick purees instead of soups, and at each meal, give puree first. b. Add a special food to your baby's serving (e.g., chicken liver, egg, or fish). c. Teach your child to eat with love, patience, and good humour.	No education	Health facility staff	Health facility	Nutrition education was given to caregivers during health facility visit, and these children were followed till 18 months.	Baseline characteristics in terms of SES were similar between the two groups; except that the intervention group has slightly better maternal education and hygiene score.	There were only slight differences in birthweight between the intervention and control groups at baseline (mean 3.41 vs. 3.35 kg) and no differences in length (cm).	-	18 mo	Intervention grp: WAZ: -0.33+-0.90 HAZ: -0.81+-0.80 Control: WAZ: -0.62+-0.83 HAZ : -1.19+-0.83

Author	Country	Region	Type of study	Age group	Intervention- what was the educational message?	Control	Who delivered?	Where was the education given?	Duration of intervention	Baseline demographics	Baseline nutritional status	Seasonal variation	Duration of follow up	Results
Vitolo 2005[32]	Brazil	Unclear	cRCT Efficacy Food secure	0-12 mo N=397	Mothers received educational guidelines for infant and child feeding from birth to 1 year postpartum through home visits. Based on 'Ten Steps to Healthy Feeding': a. Feed only breastmilk for up to 6 months. b. Gradually introduce other foods after 6 months whilst maintaining BF. c. Give CF 3¥ per day after 6 months. d. Ensure that no schedules impair the offering of CF e. Offer 'thick' foods using spoons. f. Offer child different foods during the day. g. Stimulate daily consumption of fruits/vegetables. h. Avoid sugar and other junk foods. i. Pay attention to hygiene and proper handling of food. j. Stimulate sick/convalescent to eat.	No inter-vention	Community-based nutrition educators	Homes	10 home visits, performed in the first 10 days after parturition and then monthly to 6 months, and at 8, 10, and 12 months.				12 mo	Inter-vention grp: % Anaemia: 66.2 Control: % Anaemia: 61.8

Author	Country	Region	Type of study	Age group	Intervention- what was the educational message?	Control	Who delivered?	Where was the education given?	Duration of intervention	Baseline demographics	Baseline nutritional status	Seasonal variation	Duration of follow up	Results
Bhandari 2004[27]	India	Rural	cRCT Efficacy Food secure	New-borns (10 days old or younger)/ I: 552 C: 473	Mothers received education on food preparation, food diversity, and use of amylase-rich flour. • Health and nutrition workers in intervention communities were trained (for 3 days) in age-appropriate complementary feeding (immediate before, after birth, exclusive before 4-6 mo, initiate complementary feeding 4-6 mo, education on types of food to feed, frequency of feeding, amount, child encouragement, hand washing, feeding during illness) • Health and nutrition workers in control communities did not receive any specific training or information.	No inter-vention	Health/ nutrition workers	Health facility	12 mo	The baseline character-istics of the children enrolled in the cohort in the intervention and control communities were similar, except for the proportion of mothers working outside the home, which was higher in the intervention commun-ities.	Both groups had similar birthweights at baseline.	-	18 mo	Inter-vention group: weight gain (kg): 1.16 +-0.65 length gain (cm): 6.01+-2.01 % under-weight: 54.2 % stunted: 50.1 Control: weight gain (kg): 1.15+-0.67 Length gain (cm): 5.91+-1.83 % under weight: 52.9 % stunted: 51.2

Author	Country	Region	Type of study	Age group	Intervention- what was the educational message	Control	Who delivered	Where was the education given	Duration of intervention	Baseline demographics	Baseline nutritional status	Seasonal variation	Duration of follow up	Results
Santos 2001[35]	Brazil	Urban	cRCT Efficacy Food secure	< 18 mo/ I: 209 C: 195	Health care providers were trained to deliver educational messages on food preparation and infant feeding to mothers. Key messages: a. Increase frequency of breastfeeds/complementary feeds b. Give animal protein and micronutrient-rich foods (egg, chicken liver, shredded chicken, and beef). c. Add oil to food d. Increase energy and nutrient density by giving mashed beans instead of broth and by giving thick papa instead of soup.	No inter-vention	Health facility staff	Health facility	Education intervention was delivered for outpatient clinics, and children were followed for 180 days.	The average age of the children in the intervention and control groups was similar. Despite paired randomisation, children from the intervention group had lower family income, social class, and maternal schooling.	The nutritional status of the children was very similar between groups, except for the mean weight-for-age Z-score, which was significantly higher in the control group, when all children were considered together.	-	180 d	Intervention grp: WAZ: -0.18+-0.78 HAZ: -0.37+-0.97 Control: WAZ: -0.25+-0.78 HAZ: -0.41+-0.81

Author	Country	Region	Type of study	Age group	Intervention- what was the educational message?	Control	Who delivered?	Where was the education given?	Duration of intervention	Baseline demographics	Baseline nutritional status	Seasonal variation	Duration of follow up	Results
Roy 2007[39]	Bangla-desh	Rural	cRCT Effective-ness Food insecure	Children aged 6 to 9 months who were well-nourish-ed or mildly mal-nourish-ed/ I: 306 C: 305	Weekly nutrition education based on the nutrition triangle concept of UNICEF for 6 months. The messages were prioritised for food security, psychosocial stimulation, and care and health-seeking behaviour, and were built on the preliminary exploration and focus group. The messages delivered were simple, standardised, and age-appropriate.	regular BINP services	Community health workers/ counsellors	Com-munity centre	Weekly education for 6 months	Similar SES of the two groups at baseline.	At baseline, the mean weight-for-age as a percentage of the NCHS median was comparable in the inter-vention and control groups (83.9% vs. 83.6%, respectively ; *p* = NS)	-	6 mo	Inter-vention grp: WAZ : − 1.43 ± 0.73; WL Z: − 0.64 ± 0.87 HAZ: − 1 .90 ± 0.93 Control: WAZ: − 1. 90 ± 0.79; WLZ: − 1. 14 ± 0.93 HAZ: − 2. 15 ± 0.99
Bhanda ri 2001[26]	India	Rural	RCT Efficacy food insecure	4 mo/ food supple men-tation grp: 87, nutri-tion coun-selling grp: 97, C: 91	Nutritional counselling group (NC): 30-45 min monthly counselling with no food supplement.	**Control #1**: Visitation group (V): home visits 2/wk for morbidity assess-ment; no advice. **Control #2**: Non-inter-vention group (NI): contacted at 6, 9, and 12 mo for dietary and anthro assess-ment; no other visits, no advice.	Trained nutrition-ists	Home	Monthly counselling	Children from control had almost the same demo-graphics as those in intervention.	-	-	8 mo	I: weight gain 1.93 +-0.57 Height 68.6+-2.9 % Stunted 63.9 C: weight 1.84+-0.72 Height 68.4+-2.4 % Stunted 75.8

Table 7: Description of nutritional education interventions used							
Study ID	**Current practice and focus of emphasis regarding complementary foods**	**Specific messages about complementary foods**	**Target intake from complementary foods**	**Use posters, cards, etc.**	**Cadre of worker**	**Monitor weight? Target**	**Assessed whether counselling is effective**
Shi 2009[31]	Focus was on family foods prepared from locally available and affordable, energy-dense foods.	Yes, educated on preparing home foods.	None	Yes, booklets which contained infant-feeding guidance and methods of preparing the recommended recipes.	Health care providers	Yes, no criteria	Yes
Zaman 2008[33]	-	Yes, frequency of feeding according to the child's age.	No	Yes, a local adaptation of Pakistan's IMCI 'feeding counselling card' was developed in the local language.	Lady health visitors	Yes, no criteria	Yes
Penny 2005[28]	Focus was on special foods (e.g., chicken liver, egg, or fish added to baby's serving).	Yes, use thick purees instead of soups, and at each meal, give puree first. Add a special food to your baby's serving (e.g., chicken liver, egg, or fish). Teach your child to eat with love, patience, and good humour.	No	Yes, flip charts and single-page recipe flyers.	Health facility staff	Yes, no criteria	No
Vitolo 2005[32]	Based on 'Ten Steps to Healthy Feeding': Feed only breastmilk for up to 6 months. Gradually introduce other foods after 6 months whilst maintaining breastfeeding.	Yes, give CF 3 times per day after 6 months. Ensure that no schedules impair the offering of CF. Offer 'thick' foods using spoons. Offer child different foods during the day. Stimulate daily consumption of fruits/vegetables. Avoid sugar and other junk foods. Pay attention to hygiene and proper handling of food. Stimulate sick/ convalescent to eat.					
Bhandari 2004[27]	Children were fed cereal/legume gruels or mixes. Educational messages focused on food diversity and amylase-rich flour.	Yes, age-appropriate complementary feeding (immediately before after birth, exclusive before 4-6 mo, initiate complementary feeding at 4-6 mo, education on types of food to feed, frequency of feeding, amount, child encouragement, hand washing, feeding during illness). Health and nutrition workers in control communities did not receive any specific training or information.	Yes, at 6 mo start with 0.5 *katori* of recommended foods 3 times (breastfed child) or 5 times (non-breastfed child). At 1-2 years, give: 1.5 *katori* of recommended foods five	Yes, posters were designed for display at physician clinics; flip books, a feeding recommendation card for ready reference, and a counselling guide containing a list of feeding problems, along with locally acceptable solutions were developed.	Health/nutrition workers	Yes, no criteria	No

Table 7: Description of nutritional education interventions used							
Study ID	**Current practice and focus of emphasis regarding complementary foods**	**Specific messages about complementary foods**	**Target intake from complemen-tary foods**	**Use posters, cards, etc.**	**Cadre of worker**	**Monitor weight? Target**	**Assessed whether counselling is effective**
			times/day.				
Santos 2001[35]	Focus was on animal protein and micronutrient-rich foods (egg, chicken liver, shredded chicken, and beef).	Yes, key messages: Increase frequency of breastfeeds/complementary feeds. Give animal protein and micronutrient-rich foods (egg, chicken liver, shredded chicken, and beef). Add oil to food. Increase energy and nutrient density by giving mashed beans.	No	A Mother's Card summarising the recommendations was used to assist the health provider in counselling the mothers.	Health facility staff	Yes, no criteria	Yes
Roy 2007[39]	Emphasis was placed on demonstrations of the preparation of energy- and protein-rich local complementary foods rich in micronutrients, such as *khichuri.*	No	No	No	Community health workers/counsellors	Y weight-for-age above 75% of the median NCHS standards.	No
Bhandari 2001[26]	Focus was on identifying problems with current practices through a 24-hour dietary recall and giving solutions to those problems.	No	None	Nutritional counselling guide	Trained nutritionists	Yes, no criteria	Yes

Complementary feeding with or without nutritional education

We included four studies in the meta-analysis with 512 infants that had complementary feeding combined with or without nutritional education as the intervention.[26, 41-43] Amongst these studies, two were efficacy trials[26, 41] and two were effectiveness trials.[42, 43] All of the studies were from food-insecure populations. Tables 10 and 11 represent the characteristics of all included studies that had complementary feeding with or without education as the intervention. Table 12 has reported the energy and micronutrient content from food provided in the included studies.

Effect on linear growth

Height gain

Four studies reported height gain as the outcome (Annex 2.1). All of these studies were conducted in food-insecure populations and displayed a non-significant impact on height gain (SMD 0.34; 95% CI: -0.09, 0.78, random model, n=512, four studies, tau^2= 0.15, I^2=79%, Chi^2 P value=0.002) (Annex 2.1.2). Pooled estimates based on efficacy/effectiveness were non-significant and the test of interaction was non-significant (P=0.10) (Annex 2.1.1).

Pooled analysis based on type of food showed that cereal had a significant impact on height gain as compared to usual diet (SMD 0.27; 95% CI: 0.01, 0.54; random model, n=220, two studies, tau^2= 0.00, I^2=0%, Chi^2 P value=0.49). An extruded formulated complementary diet from maize and cowpea also had a significant impact on height gain (SMD 1.13; 95% CI: 0.58, 1.68, random model). Studies that assessed the impact of food prepared from locally available raw ingredients showed no improvement in height gain (Annex 2.1.3).

Height-for-age (Z score)

Height-for-age (mean Z scores) was reported by four studies. Our results showed that complementary feeding (with or without nutritional education) resulted in non-significant improvement on HAZ (SMD 0.46; 95% CI: -0.24, 1.17, random model, n=500, four studies, tau^2= 0.46, I^2=92%, Chi^2 P value<0.001) (Annex 2.2). All of the trials were from food-insecure populations (Annex 2.2.2), and no difference was observed based on scale of trial (P=0.33) (Annex 2.2.1). Pooled analysis based on type of food showed that the results were not significant for studies that used cereal (SMD -0.01, 95% C: -0.28, 0.27). Food preparation from locally available ingredients had no impact. Whereas, extruded formulated complementary diet from maize and cowpea had a significant impact on HAZ (SMD 2.03; 95% CI: 1.40, 2.66) (Annex 2.2.3).

Table 8: Summary estimates from studies on complementary feeding with or without education: Impact differences by scale

Outcome	Efficacy (estimate)	Number of studies	Effectiveness	Number of studies
Height gain (cm)	SMD: 0.69 (95% CI: -0.12, 1.49)	2	SMD -0.01 (95% CI: -0.26, 0.23)	2
HAZ (mean Z score)	SMD 1.00 (95% CI: -0.99, 2.98)	2	SMD -0.00 (95% CI: -0.25, 0.24)	2
Stunting (HAZ <-2)	OR 0.05 (95% CI: 0.00, 9.69)	2	OR 1.23 (95% CI: 0.88, 1.73)	2
Weight gain (kg)	SMD 0.91 (95% CI: -0.86, 2.68)	2	SMD -0.05 (95% CI: -0.29, 0.19)	2
WAZ (mean Z score)	SMD 0.15 (95% CI: -0.09, 0.40)	2		
WHZ (mean Z score)	-	-	SMD 0.15 (95% CI: -0.31, 0.61)	2

Stunting

Stunting was reported by four studies. Our results showed that complementary feeding (with or without nutritional education) had no impact on rates of stunting (OR 0.23; 95% CI: 0.01, 5.84, random model, n=500, four studies, tau^2= 10.86, I^2=100%, Chi^2 P value<0.001) (Annex 2.3). All of the trials were from food-insecure populations (Annex 2.3.2), and no difference was observed based on scale of trial (P=0.23) (Annex 2.3.1). Pooled analysis based on type of food showed that the results were not significant for studies that used cereal (OR 0.85, 95% C: 0.57, 1.27). Food preparation from locally available ingredients had a significant impact (OR 1.38; 95% CI: 1.15, 1.65). Whereas, extruded formulated complementary diet from maize and cowpea had no impact (Annex 2.2.3).

Weight

Weight gain

Four studies from food-insecure populations reported on weight gain. These found no impact on weight gain (kg) (SMD 0.43; 95% CI: -0.42, 1.27, four studies, random effects, n=500, tau^2= 0.69, I^2=95%, Chi^2 P value <0.0001). The test of interaction was insignificant (P=0.29) in terms of scale of trials. Pooled analysis based on type of food showed that the results were not significant for cereal or food prepared from locally available raw ingredients. Whereas, extruded formulated complementary diet from maize and cowpea displayed a significant impact (Annex 2.4).

Weight-for-age (Z score)

Two efficacy trials from food-insecure populations reported a non-significant impact on weight-for-age (mean Z scores) (SMD 0.15; 95% CI: -0.09, 0.40) (Annex 2.5). No impact of different food products were seen on WAZ, except for locally available food (SMD 0.30, 95% CI: 0.04, 0.55).

Table 9: Summary estimates from studies on complementary feeding with or without education: impact estimates (as food secure/insecure populations)

Outcome	Food-secure populations (estimates)	Number of studies	Food-insecure populations (estimates)	Number of studies
Height gain (cm)	-	-	SMD 0.34 (95% CI: -0.09, 0.78)	4
HAZ (mean Z score)	-	-	SMD 0.46 (95% CI: -0.24, 1.17)	4
Stunting (HAZ <-2)	-	-	OR 0.23 (95% CI: 0.01, 5.84)	4
Weight gain (kg)	-	-	SMD 0.43 (95% CI: -0.42, 1.27)	4
WAZ (mean Z score)	-	-	SMD 0.15 (95% CI: -0.09, 0.40)	2
WHZ (mean Z score)	-	-	SMD 0.15 (95% CI: -0.31, 0.61)	2

Table 10: Characteristics of included studies on complementary feeding with or without education												
Study ID	**Country**	**Region**	**Type of study**	**Age group**	**Intervention**	**Control**	**Duration of intervention**	**Baseline demographics**	**Baseline nutritional status**	**Seasonal variation**	**Duration of follow up**	**Results**
Obatolu 2003[41]	Nigeria	Rural	RCT Efficacy Food secure	4 mo/ I: 30 C: 30	Extruded formulated complementary diet from maize and cowpea (L1A1).	2 groups of controls: infants of low socio-economic status without the feeding intervention (L2N) and infants of above-average socio-economic status without the feeding intervention (HN).	14 months	There were similarities in mothers' educational level, occupation, and estimated family income between the L1A1 and L2N infants.		-	14 months	Intervention grp: weight (kg) 10.07+-1.08 Length gain: 79.7+-3.3 Control: weight (kg) 6.84+-1.08 Length gain 73.7+-3.3
Bhandari 2001[26]	India	Rural	RCT Efficacy food secure	4 mo/ food supplementation grp: 87, nutrition counselling grp: 97, C: 91	Children were randomised into 1 of 2 intervention groups: Nutritional counselling group (NC): 30-45 min monthly counselling with no food supplement. Food supplementation group (FS): received fortified milk-based cereal + nutritional counselling (in addition to usual before and home foods).	**Control #1**: Visitation group (V): home visits 2/wk for morbidity assessment, no advice. **Control #2**: Non-intervention group (NI): contacted at 6, 9, and 12 mo for dietary and anthro assessment; no other visits, no advice.	8 months	Children from control had almost the same demographics as those in intervention.	-	-	8 months	I: weight gain 1.93 +-0.57 Height 68.6+-2.9 % Stunted 63.9 C: weight 1.84+-0.72 Height 68.4+-2.4 % Stunted 75.8
Oelofse 2003[42]	Zambia	Urban	RCT Effective-ness	6 mo/ I: 16 C: 14	Received centrally processed, micronutrient-fortified complementary	Continued usual diet.	6 months	-	Hb concentrations were similar at baseline between	-	6 months	I: WAZ -0.55+-0.99 Height 74.4+-1.8 Mean Hb 108+-9

Table 10: Characteristics of included studies on complementary feeding with or without education												
Study ID	**Country**	**Region**	**Type of study**	**Age group**	**Intervention**	**Control**	**Duration of intervention**	**Baseline demographics**	**Baseline nutritional status**	**Seasonal variation**	**Duration of follow up**	**Results**
			Food secure		food (dry cereal and test porridge) 60 g dry product /d equivalent to: 100% RDA vitamin A 80% RDA iron>100% RDA zinc. They received demonstrations on how to prepare the porridge and a measuring spoon to ensure the correct amount of porridge to be consumed.				the two groups, but serum iron was slightly higher in the intervention group as compared to control (10.6 vs 9.6).			C: WAZ -0.52+-1.60 Height 74.5+-3.1 Mean Hb 106+-13
Schroeder 2002[43]	Vietnam	Not clear	RCT Effectiveness Food secure	5-25 mo/ I: 114 C: 118	Mothers received education on infant feeding; malnourished children received extra food. Details of education were not specified but were based on: Community-based volunteers. a. Breastfeeding centres. b. Food variety. c. Complementary feeding. d. Health care. e. Taking care of healthy children at home.	No intervention	6 months	Not clear	Not clear	6 months		I: WAZ -1.92+-0.78 HAZ

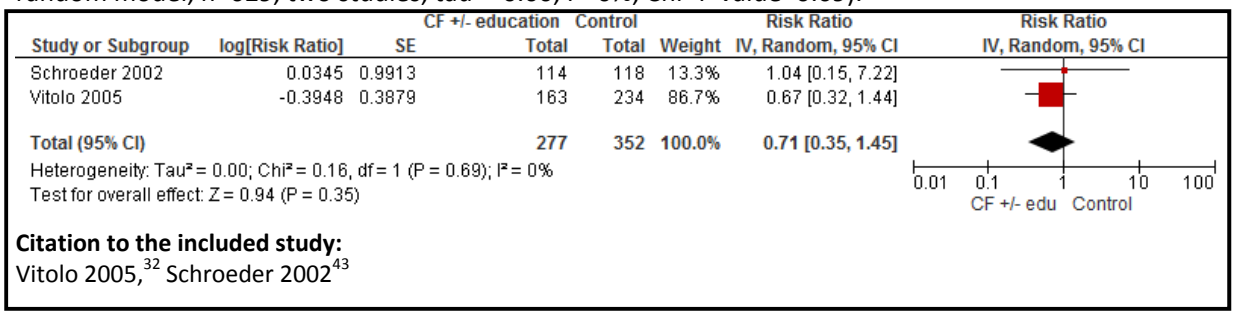
Table 11: Description of educational interventions used in studies with CF combined with nutritional education							
Study ID	**Current practice and focus of emphasis regarding complementary foods**	**Specific messages about complementary foods**	**Target intake from complementary foods**	**Use posters, cards, etc.**	**Cadre of worker**	**Monitor weight? Target**	**Assessed whether counselling is effective**
Oelofse 2003[42]		Yes, demonstrations on how to prepare the porridge and a measuring spoon to ensure the correct amount of porridge to be consumed.	1304 kJ	No	Research assistants	Yes, no criteria	No
Schroeder 2002[43]		Not specified but based on: a. Breastfeeding. b. Food variety. c. Complementary feeding. d. Health care. e. Taking care of healthy children at home.	No	No	Community-based volunteers	Yes, no criteria	No

Table 12: Details of energy and micronutrient content in the complementary foods			
Study ID	**Intervention**	**Energy density**	**Micronutrient composition/ phytate content**
Obatolu 2003[41]	Extruded formulated complementary diet from maize and cowpea (L1A1).	2,106 kJ of energy	
Bhandari 2001[26]	Milk-based cereal and nutritional counselling based on negotiating with mother changes that could be implemented in a feasible and sustainable way.	941 kJ per 50 g	Vitamin A, *RE* 111 ; Ca Pantothenate, *mg* 0.10 Vitamin D, mg 1.25; Biotin, mg 0.49 Vitamin C, *mg* 8.00; Calcium, *mg* 140.00; Vitamin E, *mg* 1.00; Phosphorus, *mg* 98.00; Vitamin K, mg 6.40; Iron, *mg* 2.70; Thiamin, *mg* 0.10; Copper, mg 135.00; Riboflavin, *mg* 0.30; Iodine, mg 12.37; Vitamin B-6, *mg* 0.02; Manganese, mg 19.70; Vitamin B-12, mg 0.43; Magnesium, *mg* 22.30; Folate, mg 8.50; Zinc, *mg* 1.35; Niacin, *mg* 0.42; Selenium, mg 0.70
Oelofse 2003[42]	Micronutrient-fortified complementary food (dry cereal and test porridge).	1,304 kJ per 60 g of dry product	Vitamin A (iu) 1200 (420)** 96; Vitamin C (mg) 40; Vitamin B1 (mg) 0.64; Vitamin B2 (mg) 0.24; Niacin (mg) 3.2; Calcium (mg) 368; Iron (mg) 8; Vitamin D (iu) 160; Vitamin E (iu) 4; Biotin (mg) 20; Folic acid (mg) 17.6; Pantothenic acid (mg) 0.6; Vitamin B12 (mg) 0.6; Vitamin B6 (mg) 0.24; Phosphorous (mg) 232; Iodine (mg) 26; Zinc (mg) 5.6; Potassium (mg) 632; Sodium (mg) 272; Chloride (mg) 440
Schroeder 2002[43]	Mothers received education on infant feeding; malnourished children received extra food.		

Morbidity

Diarrhoea

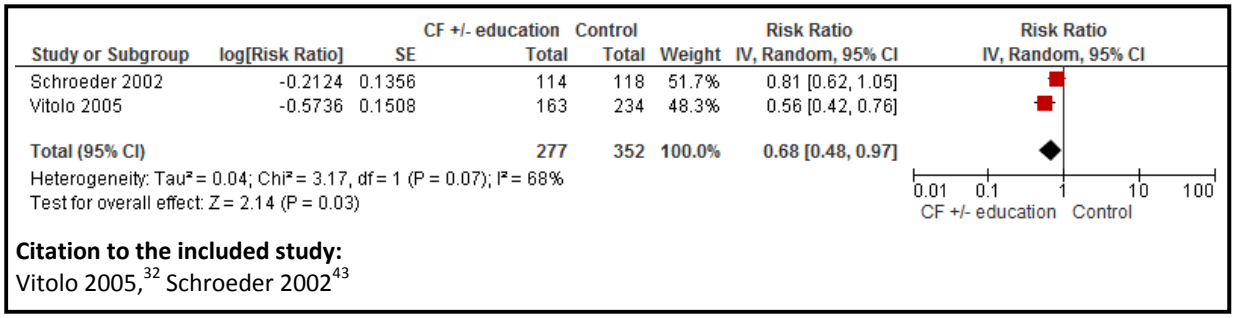
Two trials reported on this outcome. Pooled estimates were insignificant (RR 0.71; 95% CI: 0.35, 1.45, random model, n=629, two studies, tau^2= 0.00, I^2=0%, Chi^2 P value=0.69).



Citation to the included study:
Vitolo 2005,[32] Schroeder 2002[43]

Respiratory infections

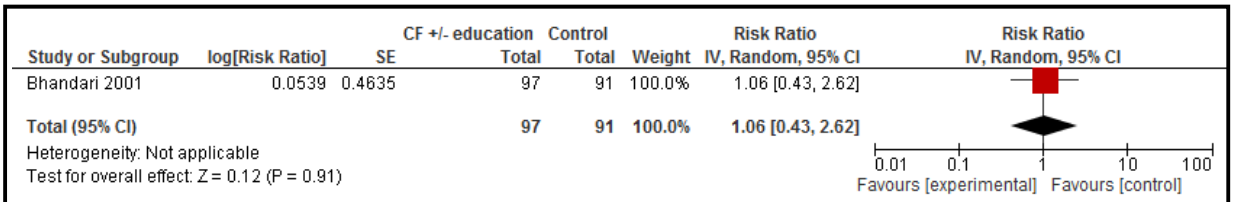
Two trials reported on this outcome. Pooled estimates showed significant impact of complementary feeding or education on complementary feeding on respiratory infections (RR 0.68; 95% CI: 0.48, 0.97, random model, n=629, two studies, tau^2= 0.04, I^2=68%, Chi^2 P value=0.07).



Citation to the included study:
Vitolo 2005,[32] Schroeder 2002[43]

Fever

Only one study reported on this outcome. Pooled estimates showed non-significant impact of complementary feeding on reducing the prevalence of fever, and there was no heterogeneity (RR 1.06; 95% CI: 0.43, 2.62, random model, n=188, one study).



Citation to the included study:
Bhandari 2001[26]

Cost

Most of the included studies did not mention estimates of cost of the intervention and complementary foods used in the trials. We personally contacted authors and attempted to get data on cost of the interventions used in the included studies (**Table 13**).

We have also made an attempt to provide cost information of different classes of complementary foods available globally. These were classified using the classification used by Pee 2009.[75] Food products were broadly classified as locally available foods, fortified blended foods, and complementary food supplements. We extracted the costs of local available foods (US$/tonne) from the FAOSTAT database (**Table 14 A**). There are variations in the cost of local food items across different regions. The cost of meat is considerably high in most LMIC countries. Plant staple food items cost much less in most countries, and, as mentioned in the discussion section, if these are processed adequately, they can have an equal impact as animal products on growth of children.

We extracted the cost of fortified blended foods and complementary food supplements from the UNICEF 2006 report on "Situation analysis on fortified complementary foods for children between 6 and 36 months of age in Latin America and the Caribbean region." The price of producing and packaging the different fortified complementary food varies considerably, depending on the main ingredients and their levels, the technical specifications for the production, and the specifications for packaging, storage, transportation, and distribution of the product. Packaging costs are highly variable, depending on the amount packaged and the quality of materials used. Small pack sizes increase the price of the final product. Shipping and internal transportation also increase the price of the final product. The price also depends on whether the fortified complementary food product is used only for social programmes, sold in the retail market, or both. When products are sold only in the retail market, they do not necessarily reach the target population.

Table 13: Cost of interventions of studies included in the review

Study ID	Product/intervention	Unit cost of complementary food/ cost of intervention
Adu-Afarwuah 2007[17]	Nutributter (LNS)	US$0.10 per 15-20g (per day) Cost of intervention: total budget of US$7,425 (for Nutributter and other 2 interventions in the trial and their shipping to Ghana). But the Sprinkles were a donation, and Nutributter took most of the budget (around 80%). Hence, total estimated cost for Nutributter in the trial was around US$5,940.
Roy 2007[39]	Educational intervention	Total cost of preventing malnutrition in one child was Taka 2,561.80 (US$37.00), 1,850.00 (US$26.81), 1,305.68 (US$18.92), and 1,473.66 (US$21.34) for Nikli, Sherpur, Chakaria, and Dacope, respectively.

We web searched different complementary food products that are available in the market (Table 14 A and B). The costs of similar products may vary amongst manufacturers primarily due to different packaging sizes. These costs may also vary considerably across regions and markets.

Table 14 A: Cost of food products as per functional classification of food types		
Context	**Cost**	**Source**
Local diet		
Chick peas (per tonne)	568.7 US$ (Bangladesh) 301.3 US$ (Ethiopia) 1,170.2 US$ (Peru) 1,304.3 US$ (Sudan)	FAOSTAT Database
Cereal, Nes	128.2 US$ (Ukraine)	FAOSTAT Database
Goat meat (per tonne)	704.0 US$ (Bolivia) 4,726.7 US$ (China) 3,269.7 US$ (Ethiopia) 3,101.8 US$ (Kenya) 4,672.1 US$ (Pakistan) 3,085.9 US$ (Ukraine)	FAOSTAT Database
Lentils (Per tonne)	715 US$ (Bangladesh) 660.8 US$ (Ecuador) 532.6 US$ (Ethiopia) 503.0 US$ (Madagascar) 865.2 US$ (Peru)	FAOSTAT Database
Maize (per tonne)	223.7 US$ (Bangladesh) 157.2 US$ (Bolivia) 273.3 US$ (Chile) 710 US$ (Ecuador) 171.0 US$ (Ethiopia) 341.0 US$ (Ghana) 322.8 US$ (Indonesia) 2,853.8 US$ (Jamaica) 217.4 US$ (Kenya) 215.6 US$ (Madagascar) 288.2 US$ (Nicaragua) 228.9 US$ (Pakistan) 156.9 US$ (Ukraine)	FAOSTAT Database
Rice, paddy (per tonne)	169.8 US$ (Bolivia) 269.1 US$ (Ecuador) 366.3 US$ (El Salvador) 421.1 US$ (Ethiopia) 488.7 US$ (Ghana) 299.4 US$ (Indonesia) 757.8 US$ (Kenya) 280.2 US$ (Madagascar) 374.2 US$ (Mali) 368.1 US$ (Nicaragua) 269.5 US$ (Peru) 295.7 US$ (Ukraine)	FAOSTAT Database
Fortified blended foods		
Corn soy blend (World Food Programme [WFP])	About US$360 per metric ton and US$0.036 per 100 g. (Higher when mix is added to the CSB mix)	UNICEF 2006
CSB flour, 100 g	0.036 US$ (Honduras)	UNICEF 2006
CSB cereal, 100 g	0.070 US$ (Nicaragua)	UNICEF 2006
CSF Papilla, 100 g	0.036 US$ (Honduras)	UNICEF 2006
CSB Soyarin, 100 g	0.045 US$ (El Salvador)	UNICEF 2006
Alli Alimentu, 250 g	0.192 US$ (Peru)	UNICEF 2006

Table 14 A: Cost of food products as per functional classification of food types		
Context	**Cost**	**Source**
(Producto Lacteo (PL), 60 g	0.116 US$	UNICEF 2006
Papilla INCAMIX, 110 g	0.100 US$	UNICEF 2006
Incaparina (New), 18.75 g	0.020 US$ (Guatemala)	UNICEF 2006
Mi Papilla, 65 g	0.098 US$ (Ecuador)	UNICEF 2006
Fruit Puree, 100 g	0.223 US$ (Cuba)	UNICEF 2006
(Nutricereal, Nutricrema, 45	0.098 US$ (Panama)	UNICEF 2006
PACFO Papilla, 90 g	0.198 US$ (Peru)	UNICEF 2006
Complementary Food Supplements (CFS)		
MNP, nutritional anaemia, 1g	4.5 US$	Pee 2009[44]
MNP, 15 V&M, 1 g	6.1 US$	Pee 2009[44]
Soy Sprinkles, 10 g		Pee 2009[44]
MixMe Plus™, 5 g	9 US$	Pee 2009[44]
RUTF		
TopNutri™, 7.5 g		Pee 2009[44]
Nutributter™, 20 g	19.8 US$	Pee 2009[44]
Plumpy Doz™, 46 g	24 US$	Pee 2009[44]
RUFC India, 50 g	15.6 US$	Pee 2009[44]
Suppl Plumpy™, 92 g	39.6 US$	Pee 2009[44]
Plumpy Nut™, 92 g	49.2 US$	Pee 2009[44]

Table 14 B: Cost of packaged food		
Food product	**Cost obtained through web search Approximate cost* (US$)**	**Cost obtained through contacting local manufacturer (PKR/US$)**
Plum Organics Mish Mash Blueberry Oats and Quinoa, 3.17-Ounce Pouches (Pack of 12)	US $ 16.06	
Earth's Best Organic Whole Grain, Rice Cereal, 8-Ounce Box (Pack of 12)	US $ 34.32	
Earth's Best Puree, Butternut Squash Pear, 4.2-Ounce (Pack of 12)	US $ 19.99	
Happy Bellies Organic Baby Cereals with DHA Plus Pre and Probiotics, Oatmeal, 7-Ounce Canisters (Pack of 6)	US $ 21.12	
Gerber Cereal, Rice Single Grain (with DHA and Probiotic), 8-Ounce Canisters (Pack of 6)	US $ 17.58	
Earth's Best Organic 2nd Wholesome Breakfast, Variety Pack, 4.5-Ounce (Pack of 12)	US $ 16.06	
Gerber Baby Cereal Oatmeal with Banana, 8-Ounce Boxes (Pack of 6)	US $ 15.48	
Gerber Yogurt Blends Snack, Apple Cinnamon, 14-Ounce (Pack of 6)	US $ 23.60	
Nestle Cerelac, Honey and Wheat with Milk, 14.11-Ounce Cans (Pack of 4)	US $ 25.62	
Nestle Cerelac, Rice/Apple/Wheat/Banana 400 g (Europe)	US $ 11.99	PKR 487.50 (US$ 5.08)
Nestle Nestum Infant Cereal 5 Cereals, 300 g (Pack of 6)	US $ 26.60	
NESTLE CERELAC GOLD 250 GM		PKR 403.00 (US$ 4.20)
NESTLE CERELAC RICE 600 GM		PKR 351.00 (US $ 3.65)
Nestle Banana 200 g		PKR 128.70 (US $ 1.34)
Nestle Cerelac mixed vegetables 300 g		PKR 221.00 (US $ 2.30)
Nestle Cerelac 3 Cereals with Milk 400 g	US $ 11.50	
Nestum Cerelac Probiotics - Infant Wheat Cereal w/ Milk-14.1 oz.	US $ 5.99	
Nestle Cerelac Baby Biscuits 150 g		PKR 143.00 (US $ 1.50)
Happy Bellies Organic Super Cereals, DHA, Multi 3-Pack (1 each Brown Rice, Oatmeal,	US $ 19.47	

Table 14 B: Cost of packaged food		
Food product	**Cost obtained through web search Approximate cost* (US$)**	**Cost obtained through contacting local manufacturer (PKR/US$)**
Multigrain 7oz)		
Plum Organics Organic Brown Rice Baby Cereal, 7-Ounce (Pack of 6)	US $ 22.14	
Gerber 2nd Foods Banana Raspberry Oat DHA Organic, 2-Count, 3.5 Ounce Jars (Pack of 8)	US $ 10.72	
Gerber Graduates Breakfast Buddies Hot cereal with Real fruit, Peach, 4.5 oz.	US $ 2.95	
Barbara's Bakery High Fiber Cereal, Original, 12-Ounce Boxes (Pack of 6)	US $ 26.28	
Gerber Cereal, Oatmeal Single Grain, 16-Ounce Boxes (Pack of 6)	US $ 21.18	
Heinz First Baby Foods, Smooth Baby Rice From 4 Months	US $ 10.34	
Heinz 6 Month Organic Biscotti Baby Biscuits 60 g	US $ 6.28	
Heinz Farley's Rusks, Original Flavor, 300 g Boxes (Pack of 6)	US $ 50.69	
Heinz 4 Month Sunrise Banana Cereal Packet 125 g	US $ 10.90	
Heinz 4 Month Med Vegetable and Rice Packet 125 g	US $ 11.05	
Heinz Breakfast Fruit with Yogurt Cereal 125 g	US $ 6.15	
Heinz 9 Month Organic Gingerbread/ Chocolate Biscotti 60 g	US $ 4.99	
Heinz 7 Month Breakfast Peachy Porridge Packet 120 g	US $ 8.99	
Heinz 4 Month Can Strawberry Cheesecake 128 g	US $ 1.99	
Baby Food Collection - Heinz Farleys Rusks, 2 x Biscotti, 2 x 6 Pack Stock Cubes AND Annabel Karmel Baby Pasta	US $ 27.99	
Farley's Rusks 6x 300 g Pack	US $ 59.55	
Toddler Mum-Mum Organic Strawberry Flavor Rice Biscuit, 24 Pieces (Pack of 6)	US $ 19.71	
Sprout Organic Toddler Meal Sweet Potato and Apple Risotto with Turkey, 6.5-Ounce	US $ 2.99	
Sprout Organic Baby Food Minestrone with Beans and Greens, Stage-3, 5.5-Ounces Pouches (Pack of 12)	US $ 24.34	
Sprout Organic Baby Food Beef and Vegetable Lasagna, 5.5-Ounce (Pack of 12)	US $ 23.88	
Sprout Organic Baby Food Butternut Squash Macaroni and Cheese, 5.5-Ounce (Pack of 12)	US $ 23.88	
Gerber Nature Select 2nd Foods, Macaroni and Cheese, 7-Ounce (Pack of 8)	US $ 13.91	
Happy Tot Toddler Meal Bowls, Vegetables, Brown Rice and Turkey, 6 Ounce Boxes (Pack of 12)	US $ 36.34	
Gerber Graduates Cookies, Arrowroot Cookies, 5.5-Ounce Pouches (Pack of 6)	US $ 13.26	
Gerber Graduates Cookies, Banana Cookies, 5-Ounce Boxes (Pack of 12)	US $ 25.12	

*Approximate costs identified via web searching. The exact costs may differ across markets and regions.

Discussion

Complementary feeding interventions include a wide variety of strategies, including nutritional education on appropriate complementary feeding practises and provision of complementary feeding either alone or in combination, food fortification, and supplementary feeding. In this review, we have included trials that evaluated the disaggregated evidence of the impact of education on complementary feeding alone, and provision of complementary feeding with or without education (excluding those on food fortification and supplementary feeding) on growth and morbidity in children less than two years of age in LMICs. However, the pooled estimates are based on RCTs alone.

There is a wide variety of complementary feeding strategies that can be studied; the outcomes used to evaluate the impact of those strategies also vary considerably. These include growth (including linear growth, weight, and other anthropometric measurements), iron status, and morbidity. We calculated a pooled effect estimate of studies reporting the same outcome. We have done comparisons based on the scale of trial (efficacy or effectiveness), food security of the study population (food secure/insecure), and the type of food provided.

The evidence showed that nutritional education alone had a significant impact on linear growth and weight gain as evident by improvement in HAZ scores, stunting, and WAZ scores. The most improvements were seen in effectiveness trials, given the nature of intervention. These results are consistent with previous reviews by Bhutta 2008[45] and Imdad 2011[5] which showed significant improvements in linear growth and weight gain with educational intervention. However, the fact to remember is that those reviews included non-randomised trials,[5, 45] and Imdad 2011[5] also included studies on malnourished children.

Table 15: Summary of estimates

Outcome	Education only	Complementary feeding with or without education
Height gain (cm)	SMD 0.14 95% CI: -0.05, 0.34 5 studies, n=2,242	SMD 0.34 95% CI: -0.09, 0.78 4 studies, n=512
Height-for-age (,mean Z scores)	**SMD: 0.22** **95% CI: 0.08, 0.37** **4 studies, n=1,486**	SMD 0.46 95% CI: -0.24, 1.17 4 studies, n=500
Stunting (HAZ <-2)	**OR 0.72** **95% CI: 0.57, 0.93** **4 studies, n=1,445**	OR 0.23 95% CI: 0.01, 5.84 4 studies, n=500
Weight gain (kg)	SMD 0.12 95% CI: -0.02, 0.26 5 studies, n=2,243	SMD 0.43 95% CI: -0.42, 1.27 4 studies, n=502
Weight-for-age (mean Z scores)	**SMD 0.20** **95% CI: 0.07, 0.33** **4 studies, n=1,673**	SMD 0.15 95% CI: -0.09, 0.40 2 studies, n=262
Underweight (WAZ <-2)	RR 1.03 95% CI: 0.90, 1.18 1 study, n=829	-
Weight-for-height (mean Z scores)	**SMD 0.20** **95% CI: 0.03, 0.36** **4 studies, n=1,466**	MD 0.15 (95% CI: -0.31, 0.61) 2 studies, n=268

Though we pooled all the studies with nutritional education together, there were considerable variations in the types of educational messages delivered. Detailed assessment of educational messages showed that most studies delivered educational interventions of reasonably good quality with appropriate use of charts, posters, and booklets. We found two studies that had the most impact on growth, one of which was of high methodological quality RCT.[15, 28] These studies gave clear messages regarding the use of affordable, animal-source products, which indicates that giving messages specifically promoting the use of nutrient-rich animal products may have an impact on growth. The study also focused on home-prepared foods. These results are consistent with Dewey 2008 and Imdad 2011.[1, 5] However, financial constraints limit the possibility of including adequate amounts of animal products in the child's diet, particularly amongst food-insecure populations. Thus, in food-insecure populations, these nutritional messages need to be combined with provision of adequate amounts of animal products. One option can be the use of protein-rich plant foods. However, most plant foods, especially staples, legumes, lentils, and vegetables contain anti-nutrients, which can reduce the bioavailability of micronutrients and interfere with digestion. These include phytate and alpha amylase. Processing is required in order to reduce the content of anti-nutrients such as phytate or addition of alpha amylase in order to increase the impact of plant foods. This is in turn associated with additional cost and required expertise.

We also reviewed the impact of trials that tested the efficacy/effectiveness of complementary feeding with or without education. There was a variety of complementary food(s) used as the intervention in the included studies. Amongst these foods were maize, fortified fat-based spread, food prepared from

locally available raw ingredients, and cereal. Though we subgrouped studies according to the type of food being tested to assess the impact of the different complementary feeding interventions on growth, iron status, and morbidity, control groups were usually children given no intervention, but in reality must have been receiving some kind of complementary feeding at home. We found that complementary feeding interventions given with or without education displayed no impact on linear growth and weight gain. Whereas, when the data from RCTs were pooled with non-RCTs, significant improvements were seen in HAZ scores, and non-significant improvement in rates of stunting. These results are again consistent with previous reviews by Bhutta 2008,[45] Dewey 2008,[1] and Imdad 2011,[5] which included non-RCTs as well.

The scarcity of available studies and their heterogeneity, as well as the variety in complementary feeding interventions, make it difficult to conclude one particular type of complementary feeding intervention as the most effective. Moreover, the variation in the reported outcomes amongst studies makes it difficult to compare them. In the future, further studies in this area must use consistent outcomes and durations of the intervention. We have identified several ongoing studies during the course of this review that can potentially provide more firm evidence than available currently. Tomedi 2011[22] is currently working on a nutrition education programme to prevent child malnutrition in Kenya. Cofie 2012[24] has completed a study recently on nutritional education in Ghana. Christian 2012[23] is studying the impact of Plumpy Doz, Wheat Soy Blend (WSB++), chickpea-based complementary food supplement, and rice-based complementary food supplementation on reducing child undernutrition in Bangladesh.

Nearly one in five children under age five in the developing world is underweight. Curing malnourishment in children is much more complex and challenging than preventing it. Malnourishment is associated with increased risk of infections, including pneumonia and diarrhoea—the major killers of children worldwide. It impairs behavioural and mental development. Despite clear evidence of the disastrous consequences of childhood nutritional deprivation in the short and long terms, nutritional health remains a low priority. Our review found that nutritional education and complementary feeding (either individually or combined) both have the potential to reduce morbidity from respiratory infections.

The evidence from the review highlights the importance of complementary feeding interventions in improving nutritional status, despite the fact that results were highly heterogeneous. Accelerated and concerted actions are needed to deliver and scale up nutritional education and complementary feeding interventions that are cost-effective, feasible, and effective in improving the nutritional status of children.

Conclusions

Education on complementary feeding alone and complementary feeding interventions with or without education have a potential to improve the nutritional status of children in developing countries. However, large, high-quality trials are required in the future to assess the impact of such interventions on growth and morbidity outcomes. Nutritional education interventions need to be combined with provision of complementary feeding that is affordable, particularly in food-insecure countries. The educational messages should emphasise the importance of appropriate, home-prepared foods, hygiene,

and high-energy foods. It is important to assess the recall of the messages by mothers once the messages are delivered.

Recommendations for policy and research

Future high-quality research trials are required, particularly from food-insecure populations, to assess the impact of such interventions on growth and morbidity outcomes. Moreover, these trials should consider using standardised types of food as the intervention so that evidence can be formulated on which type of food is most effective. It is ideal to keep the duration of intervention for at least six months, since anthropometric improvements are gradual. Trials should report consistent outcomes and also include morbidity outcomes. Despite clear evidence of the disastrous consequences of childhood nutritional deprivation in the short and long terms, nutritional health remains a low priority. Therefore, enhanced and rigorous actions are needed to deliver and scale up nutritional education and complementary feeding interventions.

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Annex I

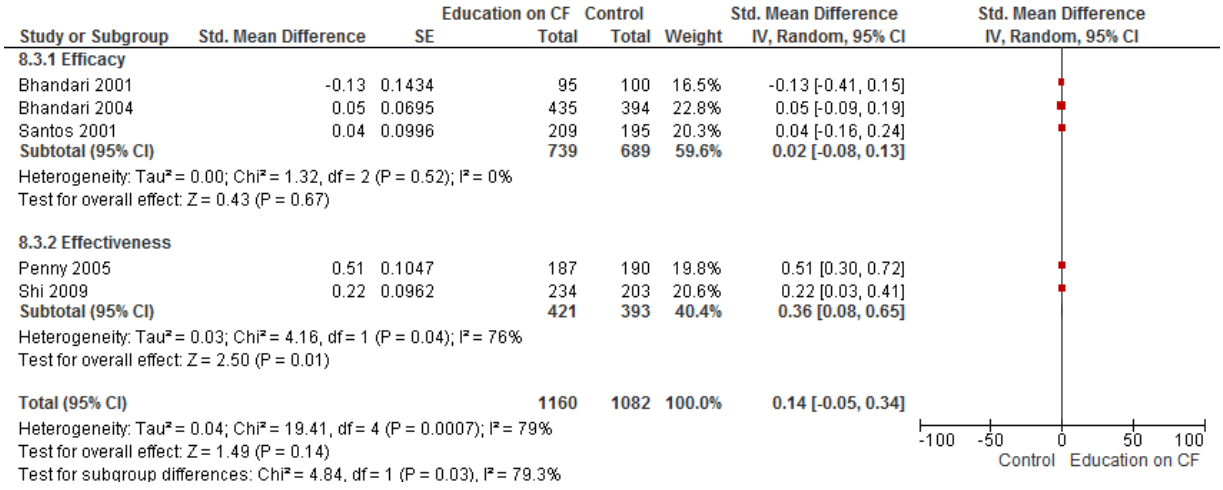
Forest plots

1.0 Education alone

Linear Growth

1.1 Height Gain (cm)

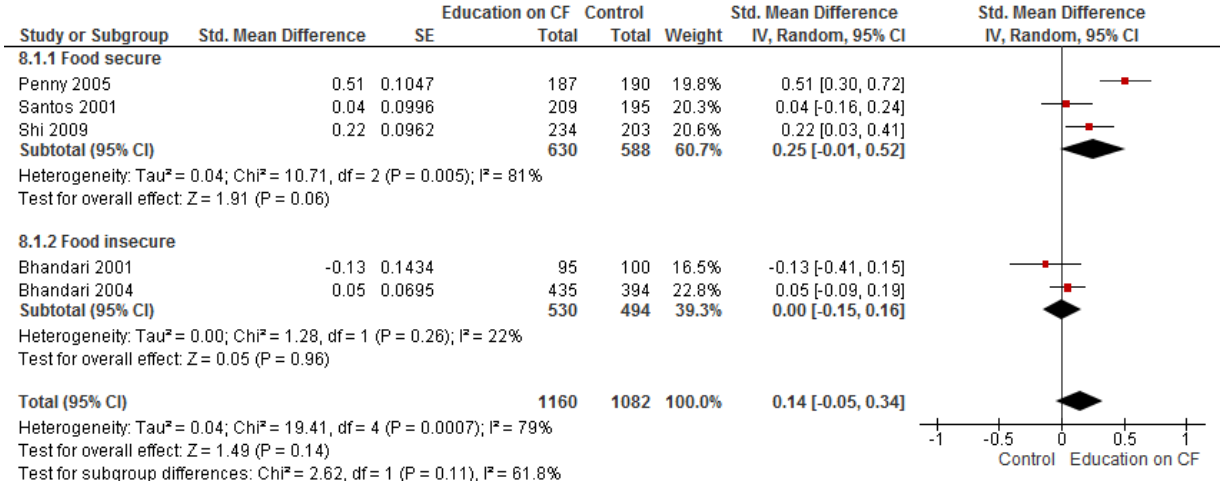
1.1.1 As efficacy/effectiveness



Citation to the included studies:

Bhandari 2001,[26] Bhandari 2004,[27] Penny 2005,[28] Santos 2001,[35] Shi 2009[31]

1.1.2 As food secure/insecure

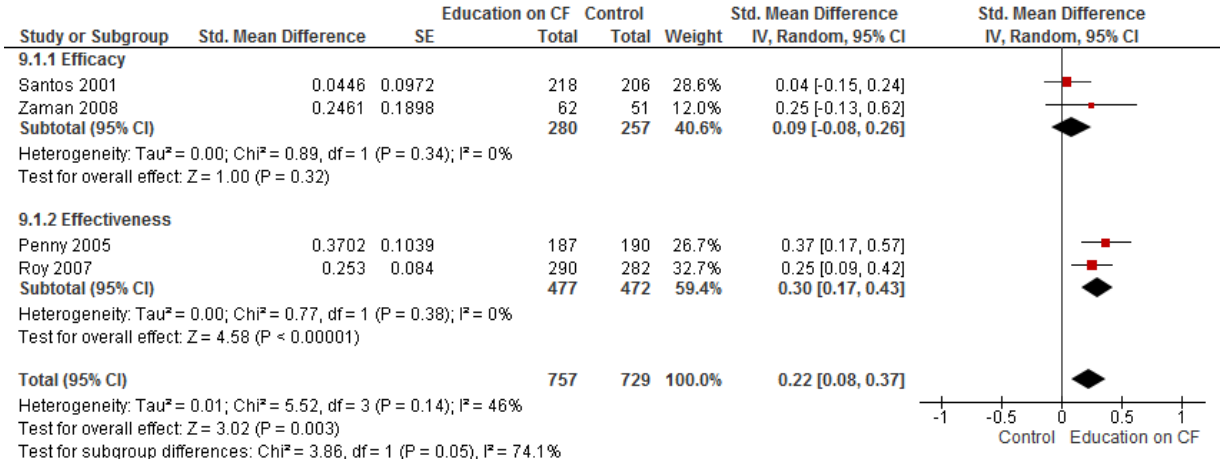


Citation to the included studies:

Bhandari 2001,[26] Bhandari 2004,[27] Penny 2005,[28] Santos 2001,[35] Shi 2009[31]

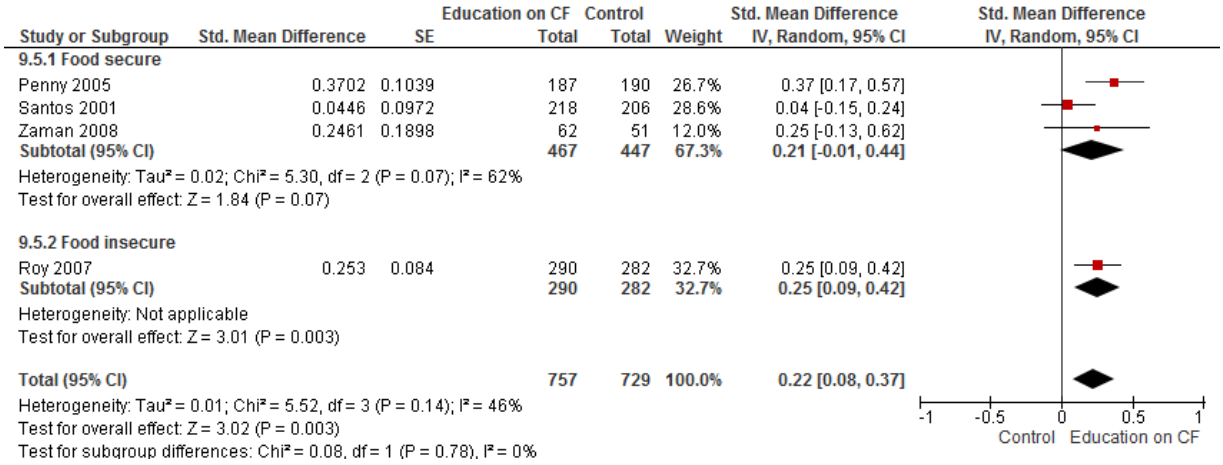
1.2 Height-for-Age (Mean Z Scores)

1.2.1 As efficacy/effectiveness



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

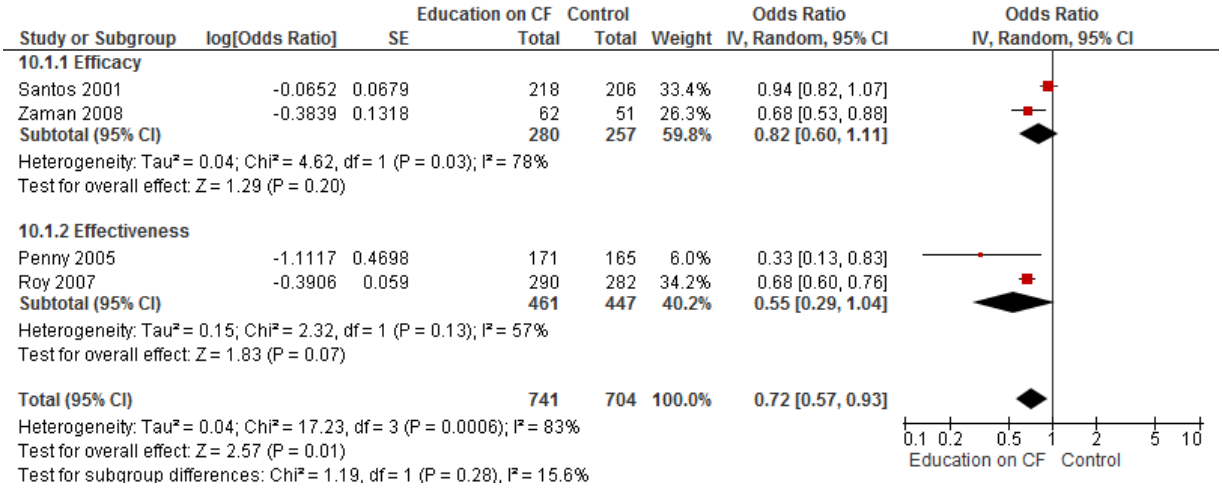
1.2.2 As food secure/insecure



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

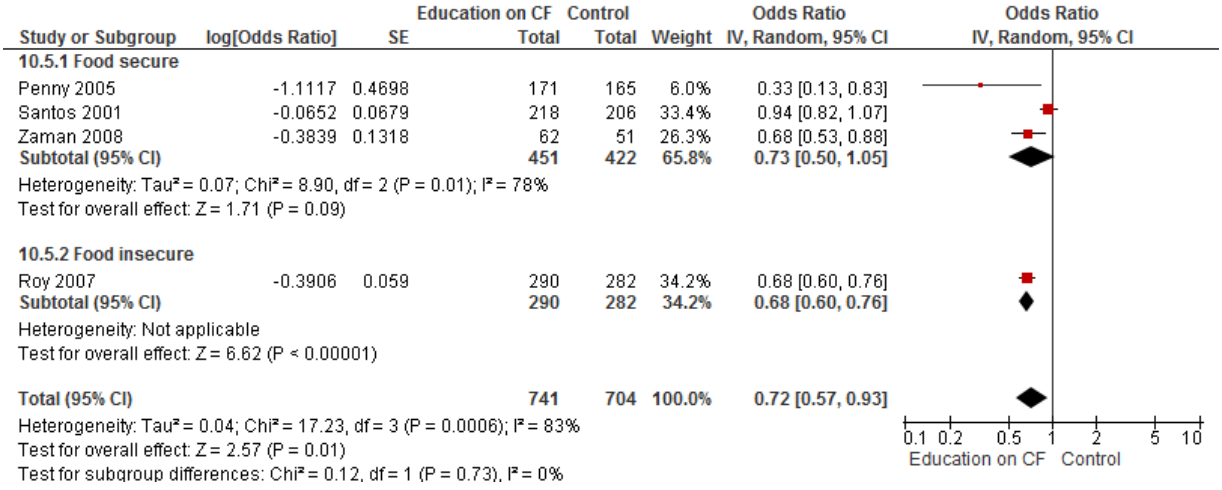
1.3 Stunting (HAZ < -2)

1.3.1 As efficacy/effectiveness



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

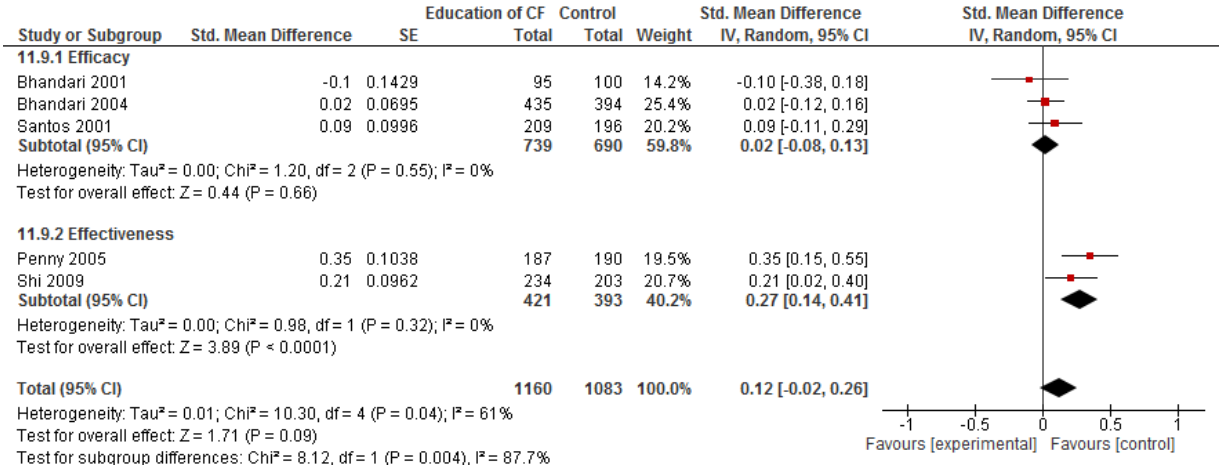
1.3.2 As food secure/insecure



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

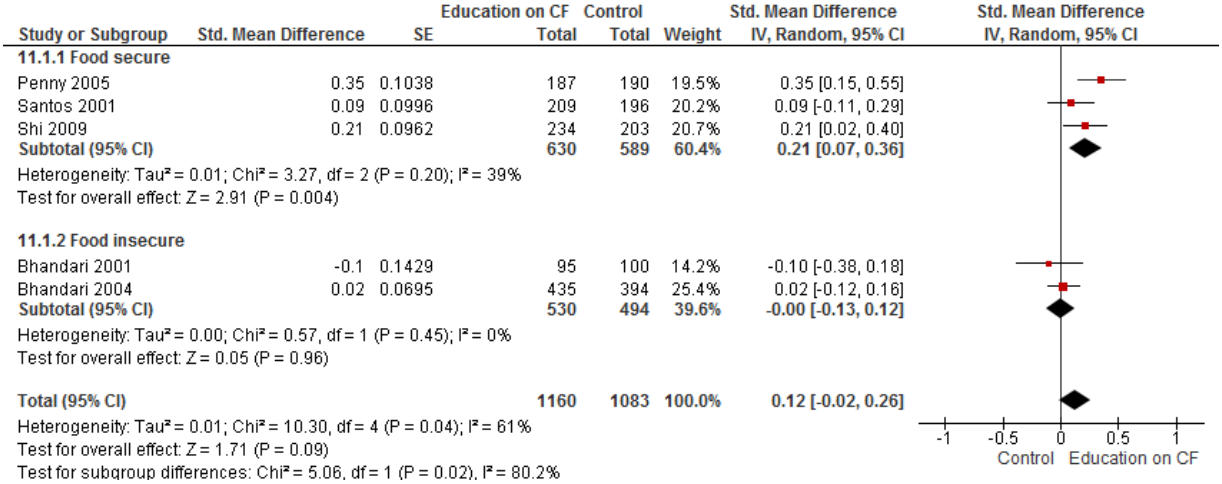
1.4 Weight Gain (kg)

1.4.1 As efficacy/effectiveness



Citation to the included studies:
Bhandari 2001,[26] Bhandari 2004,[27] Penny 2005,[28] Santos 2001,[35] Shi 2009[31]

1.4.2 As food secure/insecure

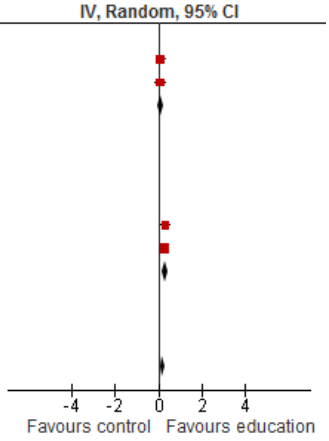


Citation to the included studies:
Bhandari 2001,[26] Bhandari 2004,[27] Penny 2005,[28] Santos 2001,[35] Shi 2009[31]

1.5 Weight-for-Age (Mean Z Scores)

1.5.1 As efficacy/effectiveness

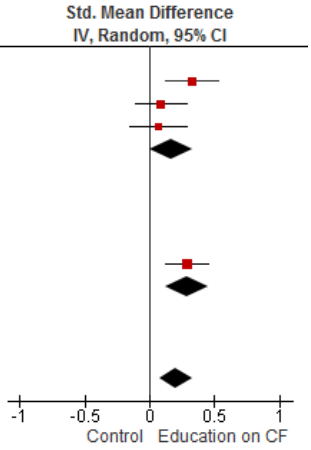
Study or Subgroup	Std. Mean Difference	SE	education Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
20.1.1 Efficacy						
Santos 2001	0.09	0.0996	209	195	24.9%	0.09 [-0.11, 0.29]
Zaman 2008	0.07	0.112	151	169	21.6%	0.07 [-0.15, 0.29]
Subtotal (95% CI)			**360**	**364**	**46.5%**	**0.08 [-0.06, 0.23]**
Heterogeneity: Tau² = 0.00; Chi² = 0.02, df = 1 (P = 0.89); I² = 0%						
Test for overall effect: Z = 1.09 (P = 0.28)						
20.1.2 Effectiveness/ Programs						
Penny 2005	0.33	0.1037	187	190	23.7%	0.33 [0.13, 0.53]
Roy 2007	0.2883	0.0841	290	282	29.8%	0.29 [0.12, 0.45]
Subtotal (95% CI)			**477**	**472**	**53.5%**	**0.30 [0.18, 0.43]**
Heterogeneity: Tau² = 0.00; Chi² = 0.10, df = 1 (P = 0.75); I² = 0%						
Test for overall effect: Z = 4.67 (P < 0.00001)						
Total (95% CI)			**837**	**836**	**100.0%**	**0.20 [0.07, 0.33]**
Heterogeneity: Tau² = 0.01; Chi² = 5.22, df = 3 (P = 0.16); I² = 43%						
Test for overall effect: Z = 3.09 (P = 0.002)						
Test for subgroup differences: Chi² = 5.10, df = 1 (P = 0.02), I² = 80.4%						



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.5.2 As food security

Study or Subgroup	Std. Mean Difference	SE	Education on CF Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
11.2.1 Food secure						
Penny 2005	0.33	0.1037	187	190	23.7%	0.33 [0.13, 0.53]
Santos 2001	0.09	0.0996	209	195	24.9%	0.09 [-0.11, 0.29]
Zaman 2008	0.07	0.112	151	169	21.6%	0.07 [-0.15, 0.29]
Subtotal (95% CI)			**547**	**554**	**70.2%**	**0.16 [0.00, 0.33]**
Heterogeneity: Tau² = 0.01; Chi² = 3.82, df = 2 (P = 0.15); I² = 48%						
Test for overall effect: Z = 1.97 (P = 0.05)						
11.2.2 Food insecure						
Roy 2007	0.2883	0.0841	290	282	29.8%	0.29 [0.12, 0.45]
Subtotal (95% CI)			**290**	**282**	**29.8%**	**0.29 [0.12, 0.45]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 3.43 (P = 0.0006)						
Total (95% CI)			**837**	**836**	**100.0%**	**0.20 [0.07, 0.33]**
Heterogeneity: Tau² = 0.01; Chi² = 5.22, df = 3 (P = 0.16); I² = 43%						
Test for overall effect: Z = 3.09 (P = 0.002)						
Test for subgroup differences: Chi² = 1.08, df = 1 (P = 0.30), I² = 7.7%						

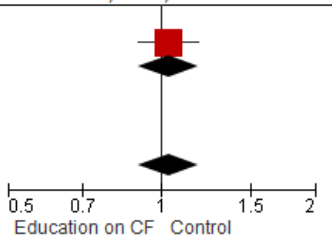


Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.6 Underweight (WAZ <-2)

1.6.1 Efficacy study from food-insecure population

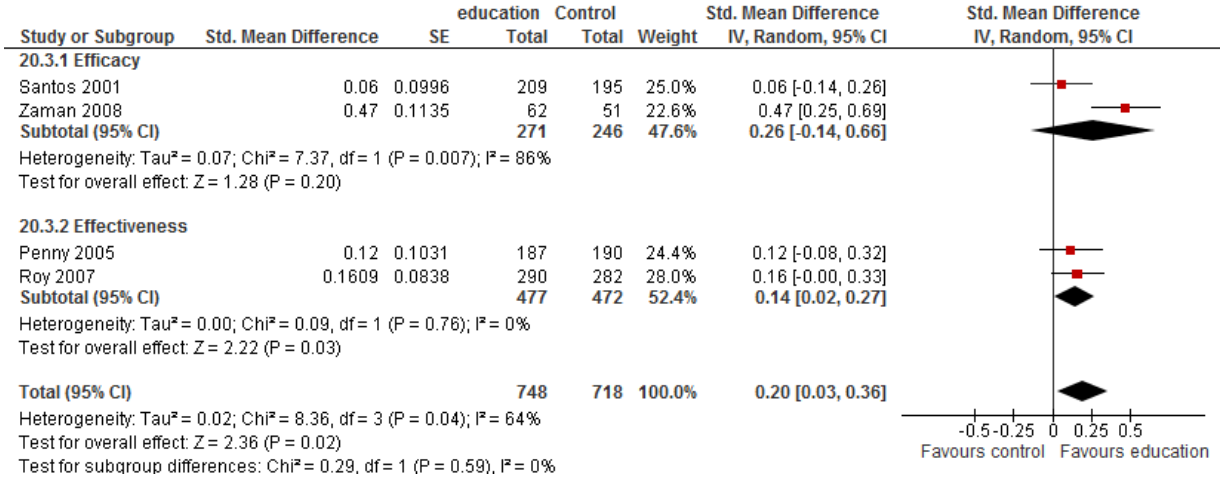
Study or Subgroup	log[Risk Ratio]	SE	Education on CF Total	Control Total	Weight	Risk Ratio IV, Fixed, 95% CI
11.3.1 Food insecure						
Bhandari 2004	0.0319	0.0699	435	394	100.0%	1.03 [0.90, 1.18]
Subtotal (95% CI)			**435**	**394**	**100.0%**	**1.03 [0.90, 1.18]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.46 (P = 0.65)						
Total (95% CI)			**435**	**394**	**100.0%**	**1.03 [0.90, 1.18]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.46 (P = 0.65)						
Test for subgroup differences: Not applicable						



Citation to the included study:
Bhandari 2004[27]

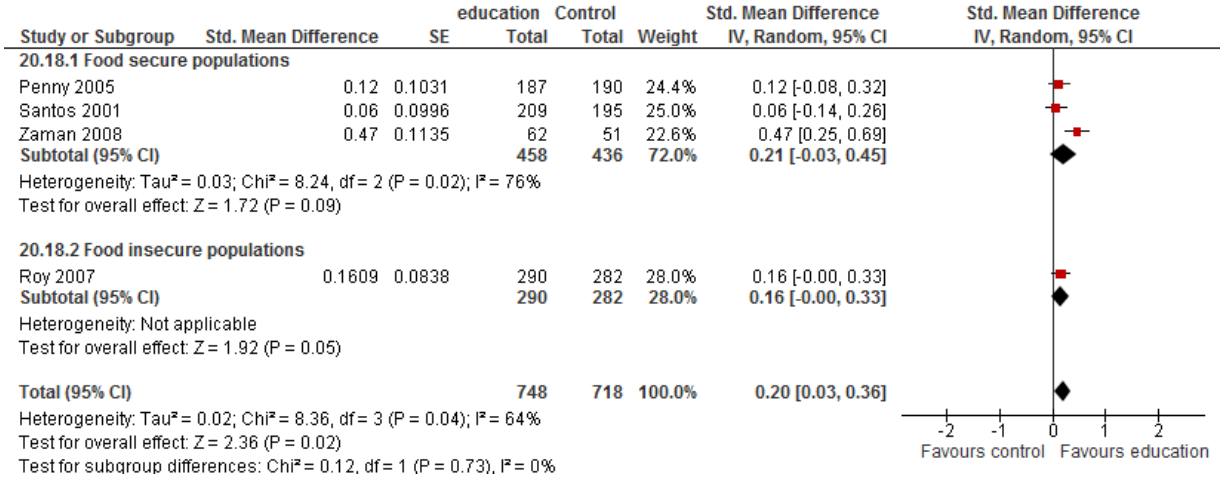
1.7 Weight-for-Height (Mean Z Scores)

1.7.1 As efficacy/effectiveness



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.7.2 As food secure/insecure



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

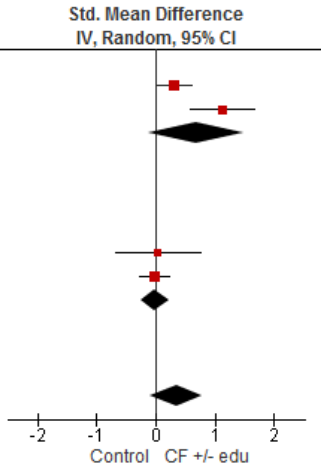
2.0 Complementary feeding plus education AND complementary feeding alone

Linear Growth

2.1 Height Gain (cm)

2.1.1 As efficacy/effectiveness

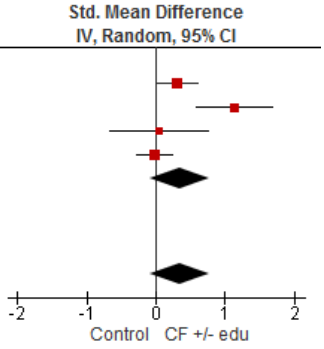
Study or Subgroup	Std. Mean Difference	SE	CF +/- edu Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
8.4.1 Efficacy						
Bhandari 2001	0.31	0.146	97	93	29.7%	0.31 [0.02, 0.60]
Obatulo 2003	1.13	0.2794	30	30	22.2%	1.13 [0.58, 1.68]
Subtotal (95% CI)			**127**	**123**	**51.8%**	**0.69 [-0.12, 1.49]**
Heterogeneity: Tau² = 0.29; Chi² = 6.77, df = 1 (P = 0.009); I² = 85%						
Test for overall effect: Z = 1.68 (P = 0.09)						
8.4.2 Effectiveness						
Oelofse 2003	0.04	0.366	16	14	17.8%	0.04 [-0.68, 0.76]
Schroeder 2002	-0.02	0.1313	114	118	30.4%	-0.02 [-0.28, 0.24]
Subtotal (95% CI)			**130**	**132**	**48.2%**	**-0.01 [-0.26, 0.23]**
Heterogeneity: Tau² = 0.00; Chi² = 0.02, df = 1 (P = 0.88); I² = 0%						
Test for overall effect: Z = 0.11 (P = 0.92)						
Total (95% CI)			**257**	**255**	**100.0%**	**0.34 [-0.09, 0.78]**
Heterogeneity: Tau² = 0.15; Chi² = 14.57, df = 3 (P = 0.002); I² = 79%						
Test for overall effect: Z = 1.54 (P = 0.12)						
Test for subgroup differences: Chi² = 2.68, df = 1 (P = 0.10), I² = 62.7%						



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

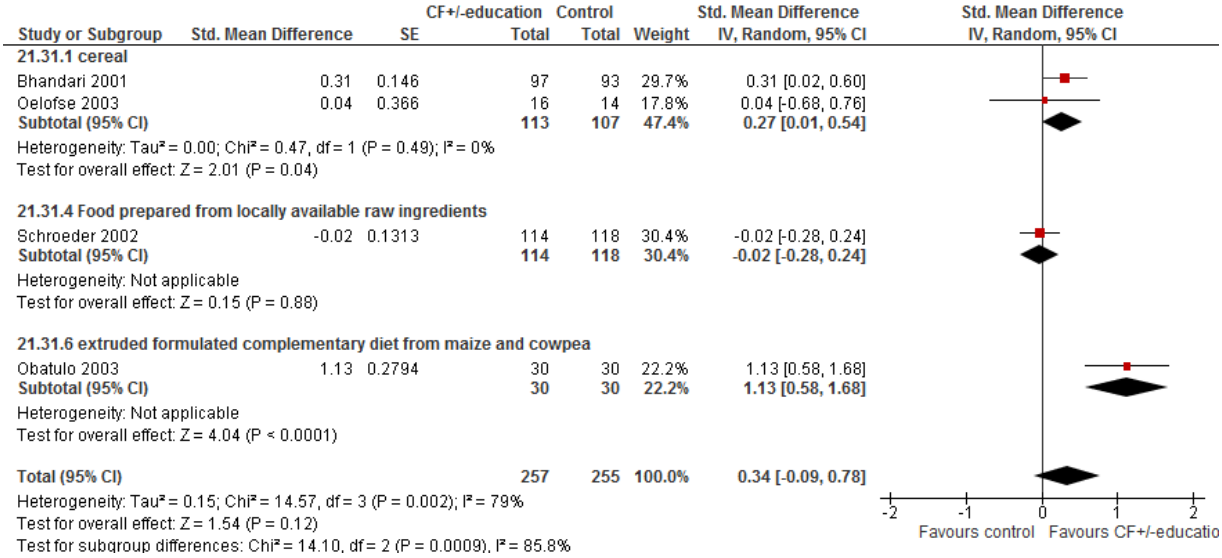
2.1.2 Food secure/insecure

Study or Subgroup	Std. Mean Difference	SE	CF +/- edu Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
8.2.1 Food insecure						
Bhandari 2001	0.31	0.146	97	93	29.7%	0.31 [0.02, 0.60]
Obatulo 2003	1.13	0.2794	30	30	22.2%	1.13 [0.58, 1.68]
Oelofse 2003	0.04	0.366	16	14	17.8%	0.04 [-0.68, 0.76]
Schroeder 2002	-0.02	0.1313	114	118	30.4%	-0.02 [-0.28, 0.24]
Subtotal (95% CI)			**257**	**255**	**100.0%**	**0.34 [-0.09, 0.78]**
Heterogeneity: Tau² = 0.15; Chi² = 14.57, df = 3 (P = 0.002); I² = 79%						
Test for overall effect: Z = 1.54 (P = 0.12)						
Total (95% CI)			**257**	**255**	**100.0%**	**0.34 [-0.09, 0.78]**
Heterogeneity: Tau² = 0.15; Chi² = 14.57, df = 3 (P = 0.002); I² = 79%						
Test for overall effect: Z = 1.54 (P = 0.12)						
Test for subgroup differences: Not applicable						



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

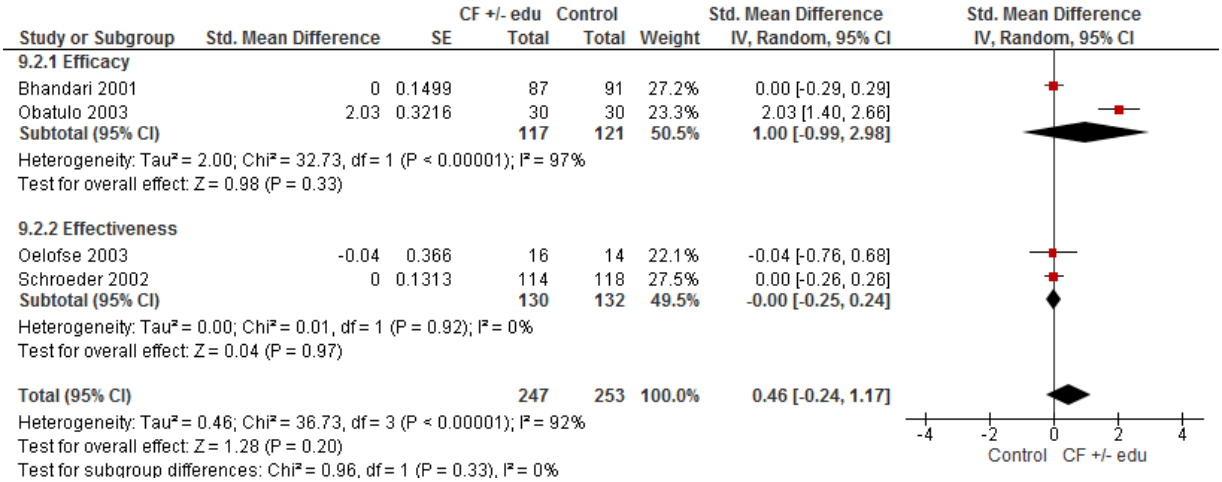
2.1.3 As type of food



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

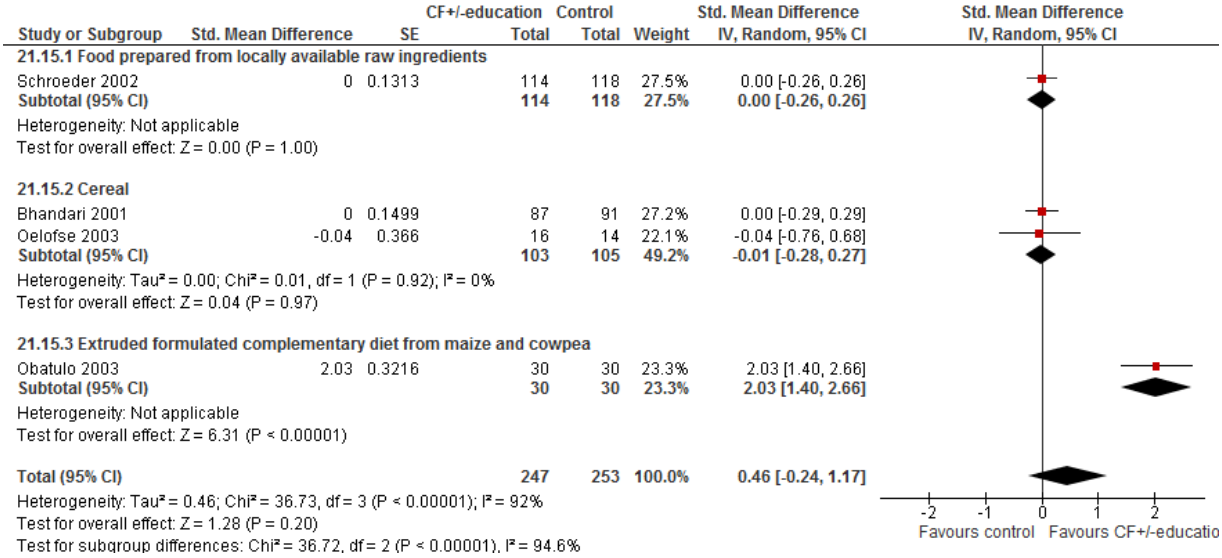
2.2 Height-for-age (Mean Z scores)

2.2.1 As efficacy/ effectiveness



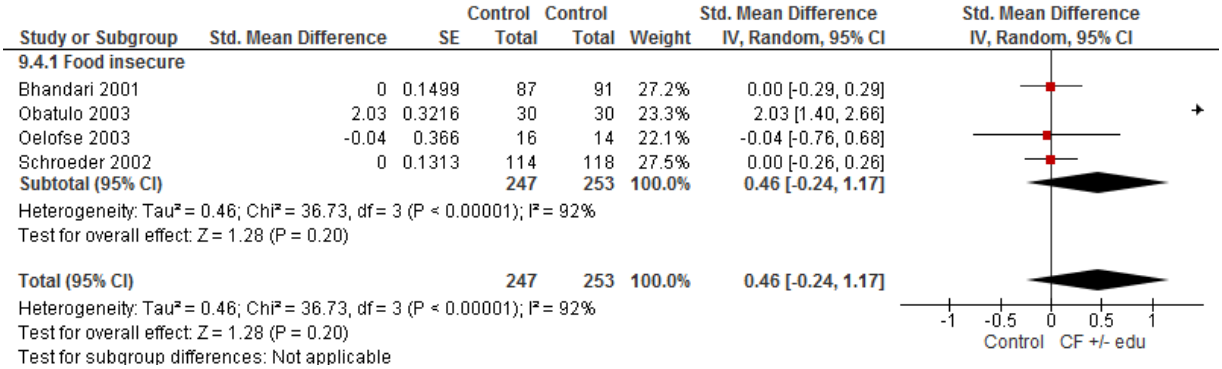
Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

2.2.2 As type of food



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

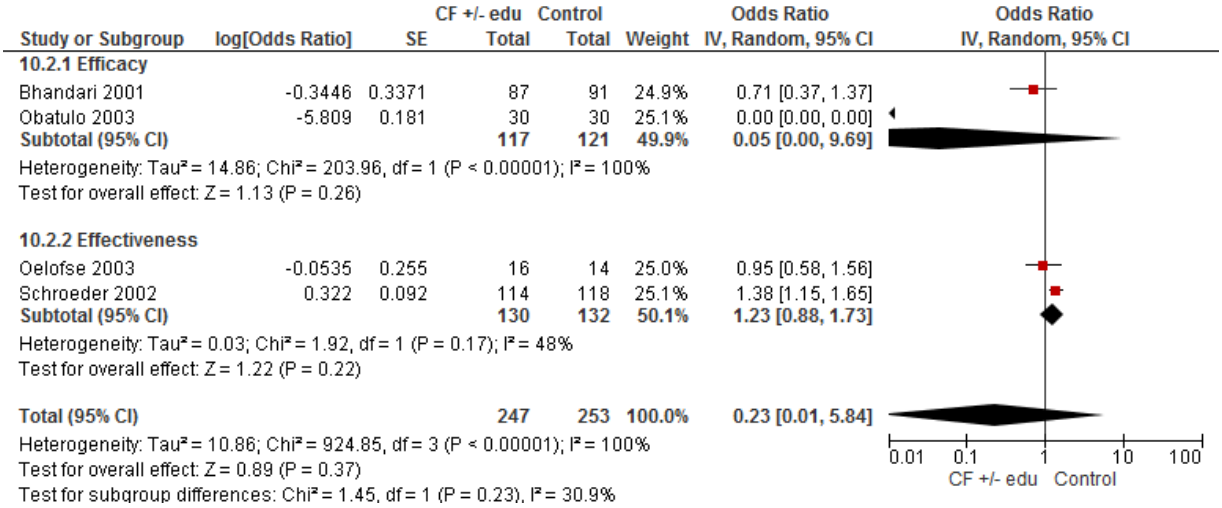
2.2.3 As food secure/insecure



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

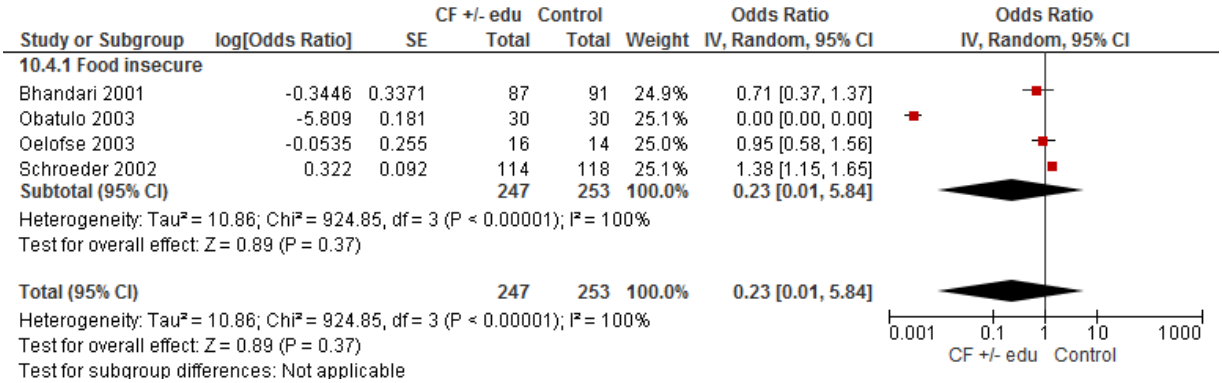
2.3 Stunting (HAZ <-2)

2.3.1 Efficacy/effectiveness



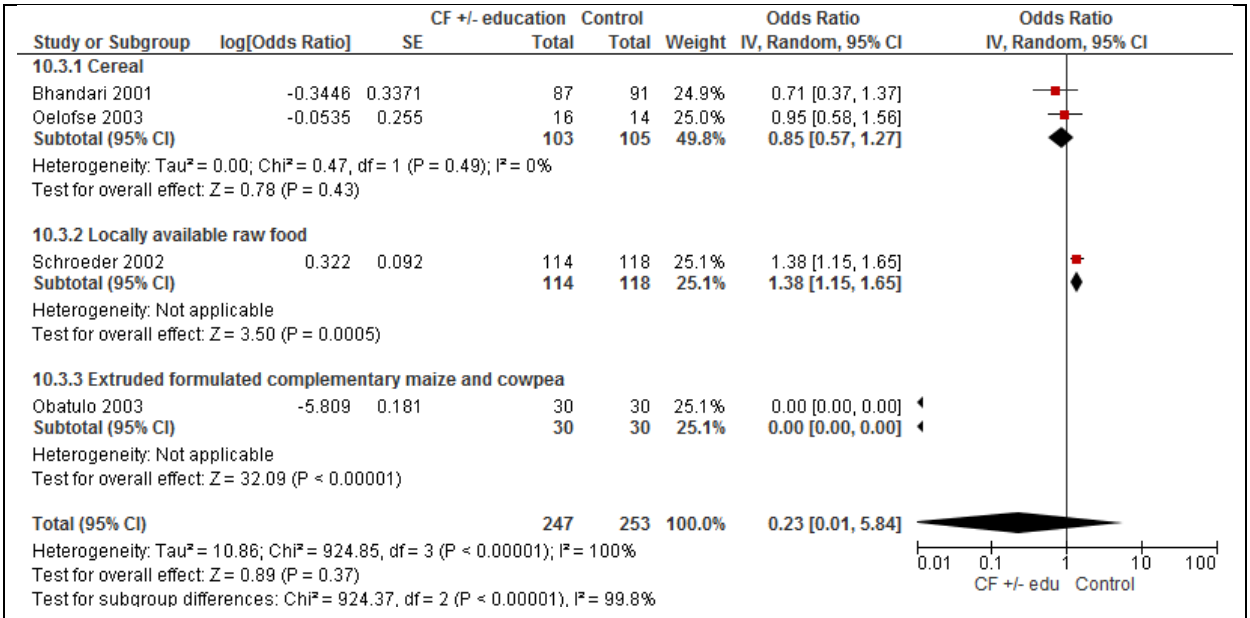
Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

2.3.2 Food secure/insecure



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

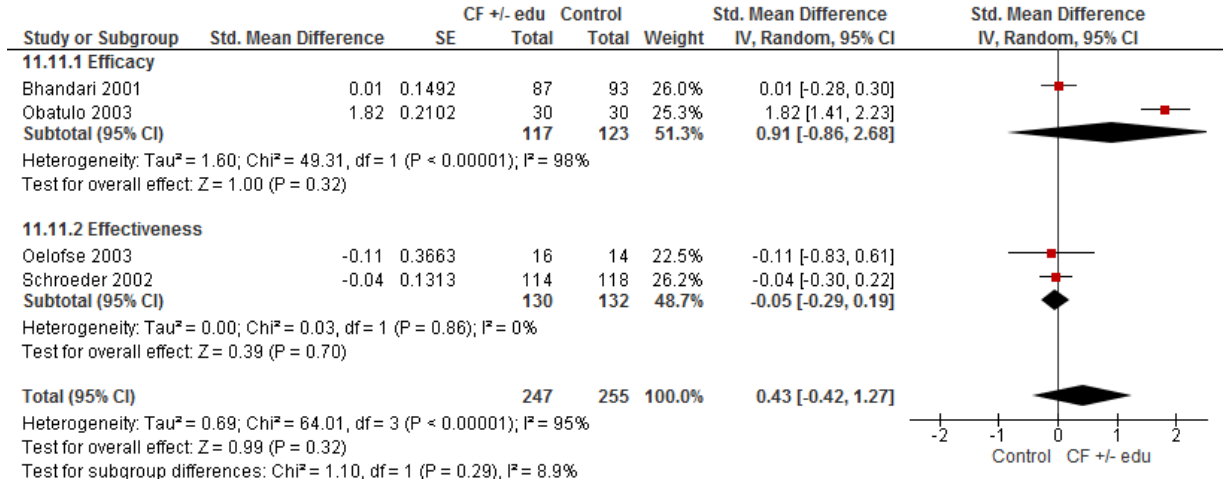
2.3.3 Type of complementary food



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

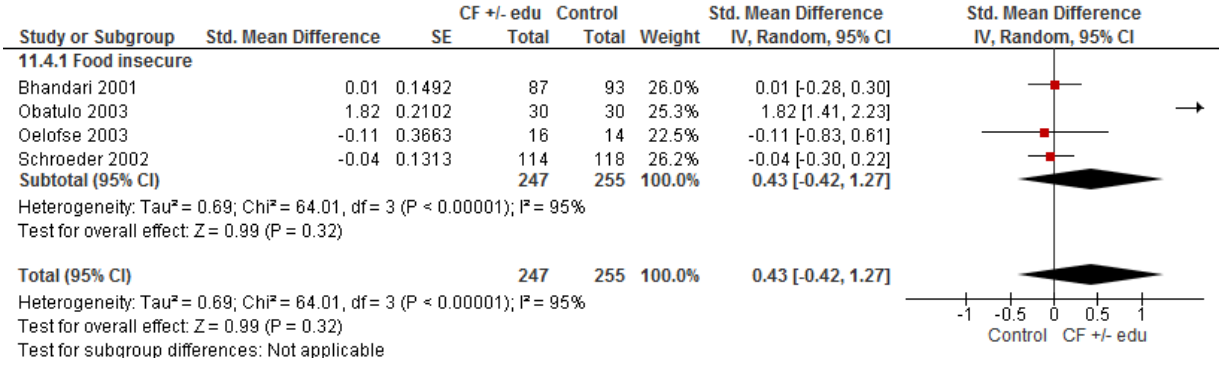
2.4 Weight Gain (kg)

2.4.1 As efficacy/effectiveness



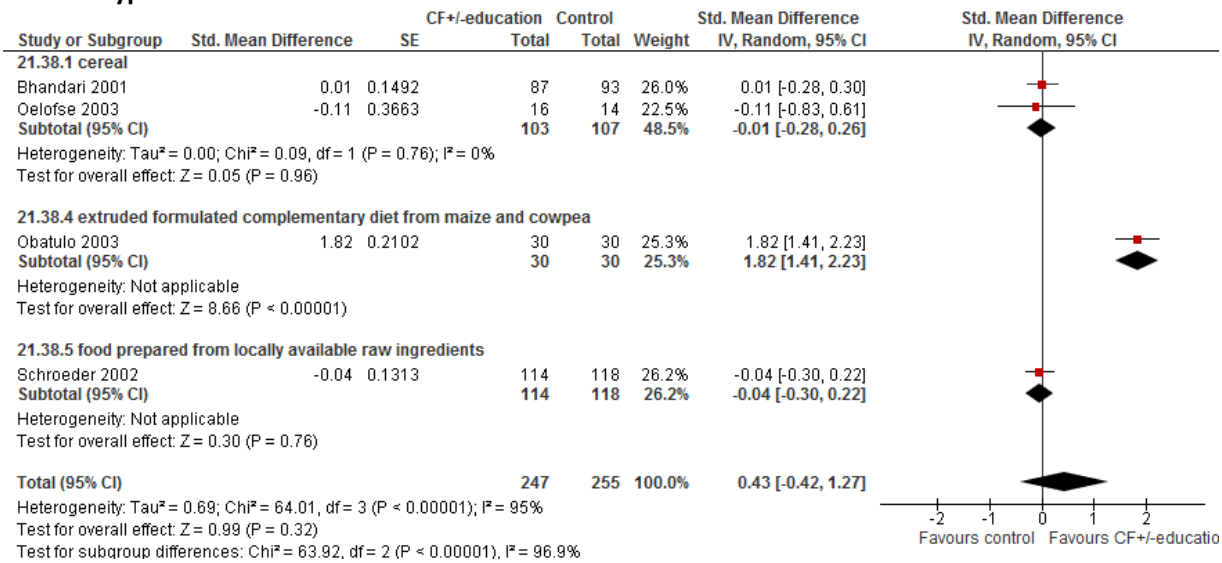
Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

2.4.2 As food secure/insecure



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

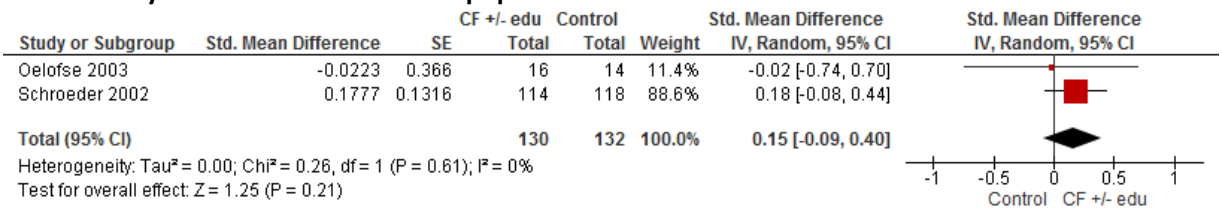
2.4.3 As type of food



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

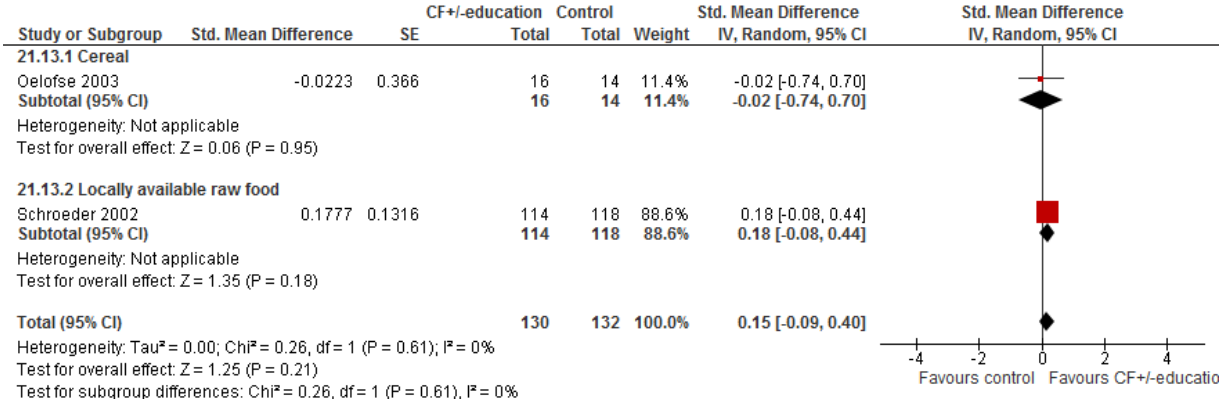
2.5 Weight-for-Age-Z Scores

2.5.1 Efficacy trials from food-insecure population



Citation to the included studies:
Oelofse 2003,[42] Schroeder 2002,[43]

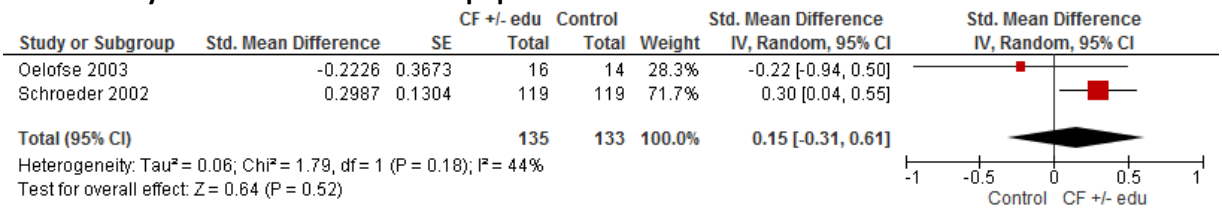
2.5.2 As type of food



Citation to the included studies:
Oelofse 2003,[42] Schroeder 2002[43]

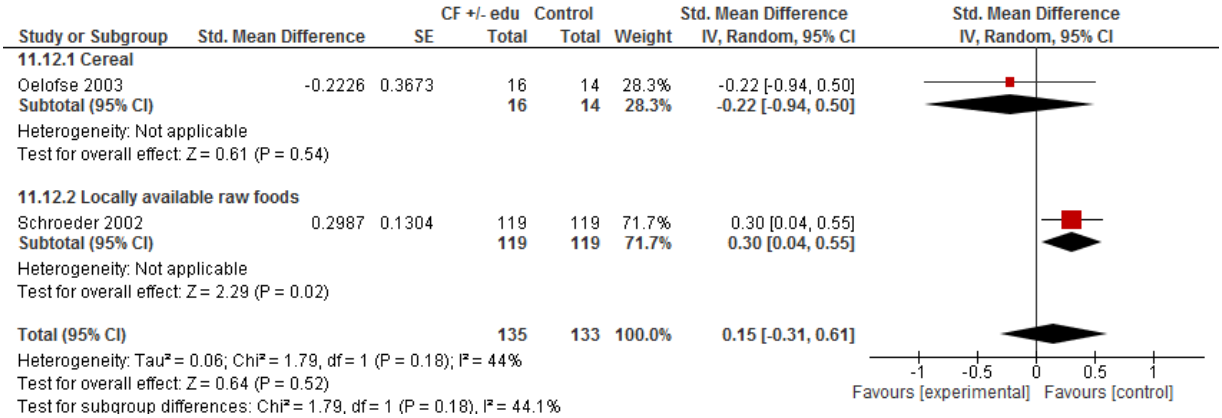
2.7 Weight-for-Height (Mean Z Scores)

2.7.1 Efficacy trials from food-insecure population



Citation to the included studies:
Oelofse 2003,[42] Schroeder 2002[43]

2.7.2 Type of food



Citation to the included studies:
Oelofse 2003,[42] Schroeder 2002[43]

Annex II

Characteristics of excluded studies	
Author / Year	**Reason for exclusion**
Thakwalakwa 2012[49, 50]	The groups received supplementation food (corn-soy blend vs. lipid-based nutrient supplementation) for three months. Thus, we excluded this study since it did not test the effectiveness or efficacy of a complementary food and was thus beyond the scope of our current review.
Isanaka 2009[51]	The intervention group received Ready-to-Use Therapeutic Foods (RUTFs). This was excluded because the intervention aimed at treating malnutrition and those at high risk for malnutrition rather than preventing it. Also, as mentioned above, the intervention group did not receive complementary food per se, and thus the study was beyond the scope of this review.
Grellety 2012[52]	The intervention group received ready-to-use supplementary foods. We excluded it because it took place during the hunger/gap season.
Huybregts 2012[53]	Study tested the impact of blanket supplementation to reduce cumulative wasting incidence during the seasonal hunger gap (June to October).
Patel 2005[54]	As above, the intervention group received RUTFs. This was excluded because the intervention aimed at treating malnutrition and those at high risk for malnutrition rather than preventing it. Also, as mentioned above, the intervention group did not receive complementary food per se, and thus the study was beyond the scope of this review.
Oliveira 2006[55]	The intervention group was given a supplementary diet (bran-based cereal mixture (multi-mixture)) and not a complementary food. Since our review focuses only on complementary feeding interventions and not supplementary feeding, we excluded this study.
Ferreira 2008[56]	The intervention group was given a supplementary diet (bran-based cereal mixture [multi-mixture]) and not a complementary food. Since our review focuses only on complementary feeding interventions and not supplementary feeding, we excluded this study.
Faber 2005[57]	The intervention group received fortified porridge. The control group received similar unfortified porridge.
Zlotkin 2003[58]	The study evaluated the use of micronutrient alone.
Moursi 2003[59]	The intervention group received maize/soya-based flour that contained amylase. The control group received identical flour without amylase.
John & Gopaldas 1993[60]	Both groups received identical gruels with differences in the energy densities.
World Vision Mongolia 2005[61]	Intervention group received micronutrient alone (Sprinkles).
Menon 2007[62]	Children receiving food assistance (fortified wheat/soy blend) were given Sprinkles.
Giovannini 2006[63]	Children received added micronutrients through home fortification with Sprinkles.
Dhingra 2004[64, 65]	Children received added micronutrients in a milk supplement.
Sharieff 2006[66]	Infants received Sprinkles added to complementary foods daily. Both groups received identical complementary foods.
Walter 1993[67]	Children received fortified (electrolytic Fe 55 mg per 100 g of dry power) rice cereal daily. Control received unfortified rice cereal.
Villalpando 2006[68]	Children received added micronutrients in milk product. Control received milk product only.

Schumann 2005[69]	Children received black beans fortified with haem. Control received identical unfortified black beans.
Javaid 1991[70]	Children received milk cereal fortified with Fe. Control group received unfortified milk cereal.
Kuusipalo 2006[71]	Included only underweight and severely stunted children.
Beckett 2000[72-75]	Children received milk product with different energy contents with or without Micronutrients.
Hirve 2006[76]	Children were given micronutrient alone.
Morgan 2004[77]	All the studies included in this review were conducted in UK.
Krebs 2006[78]	The study was conducted in USA.
Lucas 1999[79]	The study was conducted in UK.
He 2005[80]	The study included children aged 3 to 5 years from 7 kindergartens.
Davidsson 2009[81]	Intervention group received fortified cereal, and control group was given unfortified, identical cereal.
den Besten 1998[82]	Both groups received identical food with the amylase added to the food given to the intervention group.
Hoffman 2003[83]	Children were given formula milk, and the study was conducted in the USA.
Harrington 2011[84]	Both groups were given sweetened drink based on degermed maize flour and milk.
Domellöf 2002[85]	Children were given micronutrient alone.
Morley 1999[86]	The study was conducted in the UK, and it used formula milk.
Lind 2004[87]	The study is from a developed country.
Shamah-Levy 2008[88]	Intervention group received Nutrisano fortified with Sprinkles. Control group received regular Nutrisano.
Owino 2011[89]	This study was excluded because both groups received different complementary foods (RUCFs vs UMIX-corn-soy blend) and there was no comparison group. Therefore, we could not assess the impact of one complementary food.
Phuka 2008[90]	One type of complementary food was compared with another type.
Manno 2011[91]	Intervention group received multi-micronutrient-fortified porridge. Control group received identical, unfortified porridge.
Liu 1993[92]	Intervention group received fortified rusk. Control group received identical unfortified rusk.
Oue´draogo 2010[93]	Intervention group received multi-micronutrient-fortified improved gruel. Control group received identical, unfortified improved gruel.
Rim 2008[94]	It was a systematic review.
Makrides 2002[95]	The study was conducted in Australia.
Tuthill 2006[96]	Intervention group received "no iron added" formula, whereas control group received iron-supplemented formula.
Hess 2011[97]	Intervention group received fortified porridge with LNS. Control group received identical unfortified porridge with LNS.
Phu 2010[98]	Intervention group received fortified gruel. Control group received identical, unfortified gruel.
Birch 2002[99]	Used infant formula as intervention.
Kattlemann 2001[100]	This study was done in the USA.
Roy 2005[29]	The study included moderately malnourished children, and the intervention was delivered for less than six months.
Guyon 2009[101]	It was a “before and after” trial.
Bisimwa 2012[102]	The study was excluded because both the groups received complementary food (either RUCF or UNIMIX)
Aboud 2008[36]	This study from Bangladesh provided standard education to both interventions and control groups for 12 months and then an additional six sessions for a week in the intervention group only.

Hotz & Gibson 2005[37]	This study from Malawi, measuring the effectiveness of education intervention, was assessed after eight weeks.
Kapur 2003[34]	This study from India provided educational intervention and followed up in four months.
Brown 1992[38]	This was a quasi-experimental study from Bangladesh which tested the efficacy of weaning education intervention in five months.
Islam 2008[103]	This study from Bangladesh provided three different intervention for 27 days only.
Owino 2007[104]	This study from Zambia provided processed cereal/legume blend without amylase for three months.
Simondon 1996[105, 106]	This study from Congo, Senegal, Bolivia, and Caedonia provided food intervention for three months only.
Walker 1991[107-110]	This study from Jamaica included stunted children.
Husaini 1991[111]	This study from Indonesia supplemented complementary food intervention for 90 days.
Lachat 2006[112]	This study from Tanzania delivered intervention for an undescribed period of time.
Cohen 1995[113]	This study from Honduras studied the impact of food started at four months.
Lartey 1999[20]	This study from Ghana evaluated the impact of four different kinds of food products on child growth.
Santos 2005[30]	This study from Brazil assessed the impact of the Milk Supplement Programme on undernourished children.
Lutter 1990[47]	This study predominantly studied the impact of supplementary feeding in which children received enriched bread, powdered skim milk, and vegetable oil, as did all other family members. They also received education based on raising awareness about good early childhood nutrition.
Akalu 2010[46]	This study from Ethiopia provided quality protein maize (QPM) seeds to the intervention arm, whereas the control arm received conventional maize. Since the study provided commodity (seeds) and not food itself, it is excluded.
Smuts 2005[114]	The study provided daily MN foodlets which were mixed with porridge. The main intention was to assess the impact of micronutrients.
Mazariegoes 2004[48]	The intervention improved the phytate concentration of maize and was compared with regular maize.
Maluccio & Flores 2004[115]	In this effectiveness trial, mothers received cash transfers and education, not specified but based on breastfeeding, child feeding, illness care, and household sanitation and hygiene. None of the outcomes reported in the study was of any interest to this review.
Rivera 2004[116]	Children and pregnant and lactating women in participating households received fortified nutrition supplements, and the families received nutrition education, health care, and cash transfers.
Zavaleta 2011[117]	Complementary food (40g/day) with the protein source being the milkfat globule membrane (MFGM) protein fraction was compared with complementary food (40g/day) with the protein source being skim milk proteins.

Web Annex

This section has evaluated the impact of education on complementary feeding and complementary feeding with or without education on linear growth, weight, and morbidity; we meta-analysed all RCTs and non-RCTs in this section. The table below has summarised the estimates, and Tables 1, 2, and 3 present all the forest plots.

Meta-analysis of RCTs with non-RCTs

Summary of estimates		
Outcome	**Education only**	**Complementary feeding with or without education**
Height gain (cm)	SMD 0.23 95% CI: -0.00, 0.45 6 studies, n=2,737	SMD 0.34 95% CI: -0.09, 0.78 4 studies, n=512
Height-for-age (Mean Z Scores)	**SMD: 0.23** **95% CI: 0.09, 0.36** **5 studies, n=1,981**	**SMD 0.39** **(95% CI: 0.05, 0.73)** **7 studies, n=1,652**
Stunting (HAZ <-2)	**OR 0.71** **95% CI: 0.56, 0.91** **5 studies, n=1,940**	OR 0.33 95% CI: 0.11, 1.00 7 studies, n=1,652
Weight gain (kg)	SMD 0.26 95% CI: -0.00, 0.52 7 studies, n=2,980	SMD 0.43 95% CI: -0.42, 1.27 4 studies, n=502
Weight-for-age (Mean Z Scores)	**SMD 0.16** **95% CI: 0.05, 0.27** **6 studies, n=2,410**	SMD 0.26 95% CI: -0.04, 0.48 3 studies, n=527
Underweight (WAZ <-2)	RR 1.03 95% CI: 0.90, 1.18 1 study, n=829	**RR 0.35** **95% CI: 0.16, 0.77** **1 study, n=319**
Weight-for-height (Mean Z Scores)	**SMD 0.20** **95% CI: 0.03, 0.36** **4 studies, n=1,466**	MD 0.22 (95% CI: 0.07, 0.36) 4 studies, n=765
Wasting (WHZ <-2)	RR 0.07 95% CI: 0.00, 1.14 1 study, n=495	-
Haemoglobin (g/L)	**SMD 0.35** **95% CI: 0.17, 0.52** **1 study, n=495**	-
Anaemia (hb<110 g/L)	RR 0.69 95% CI: 0.25, 1.88 1 study, n=495	**RR 0.76** **95% CI: 0.59, 0.97** **2 studies, n=278**

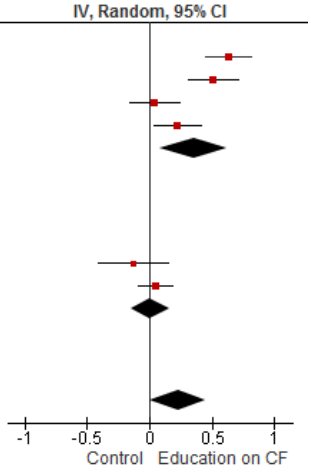
1.0 Education alone

Linear Growth

1.1 Height Gain (cm)

As food secure/insecure

Study or Subgroup	Std. Mean Difference	SE	Education on CF Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
5.1.1 Food secure						
Guldan 2000	0.63	0.0921	250	245	17.1%	0.63 [0.45, 0.81]
Penny 2005	0.51	0.1047	187	190	16.5%	0.51 [0.30, 0.72]
Santos 2001	0.04	0.0996	209	195	16.8%	0.04 [-0.16, 0.24]
Shi 2009	0.22	0.0962	234	203	16.9%	0.22 [0.03, 0.41]
Subtotal (95% CI)			**880**	**833**	**67.3%**	**0.35 [0.08, 0.62]**
Heterogeneity: Tau² = 0.06; Chi² = 23.08, df = 3 (P < 0.0001); I² = 87%						
Test for overall effect: Z = 2.58 (P = 0.010)						
5.1.2 Food insecure						
Bhandari 2001	-0.13	0.1434	95	100	14.8%	-0.13 [-0.41, 0.15]
Bhandari 2004	0.05	0.0695	435	394	17.9%	0.05 [-0.09, 0.19]
Subtotal (95% CI)			**530**	**494**	**32.7%**	**0.00 [-0.15, 0.16]**
Heterogeneity: Tau² = 0.00; Chi² = 1.28, df = 1 (P = 0.26); I² = 22%						
Test for overall effect: Z = 0.05 (P = 0.96)						
Total (95% CI)			**1410**	**1327**	**100.0%**	**0.23 [-0.00, 0.45]**
Heterogeneity: Tau² = 0.07; Chi² = 42.67, df = 5 (P < 0.00001); I² = 88%						
Test for overall effect: Z = 1.95 (P = 0.05)						
Test for subgroup differences: Chi² = 4.88, df = 1 (P = 0.03), I² = 79.5%						

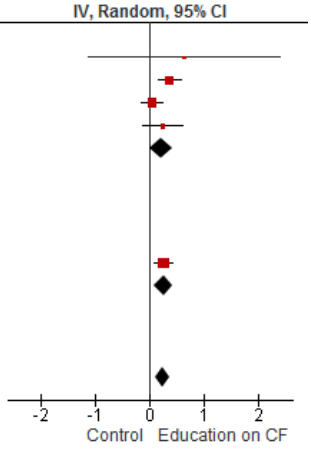


Citation to the included studies:
Bhandari 2001,[26] Bhandari 2004,[27] Penny 2005,[28] Santos 2001,[35] Shi 2009,[31] Guldan 2000[15]

1.2 Height-for-Age (Mean Z Scores)

As food secure/insecure

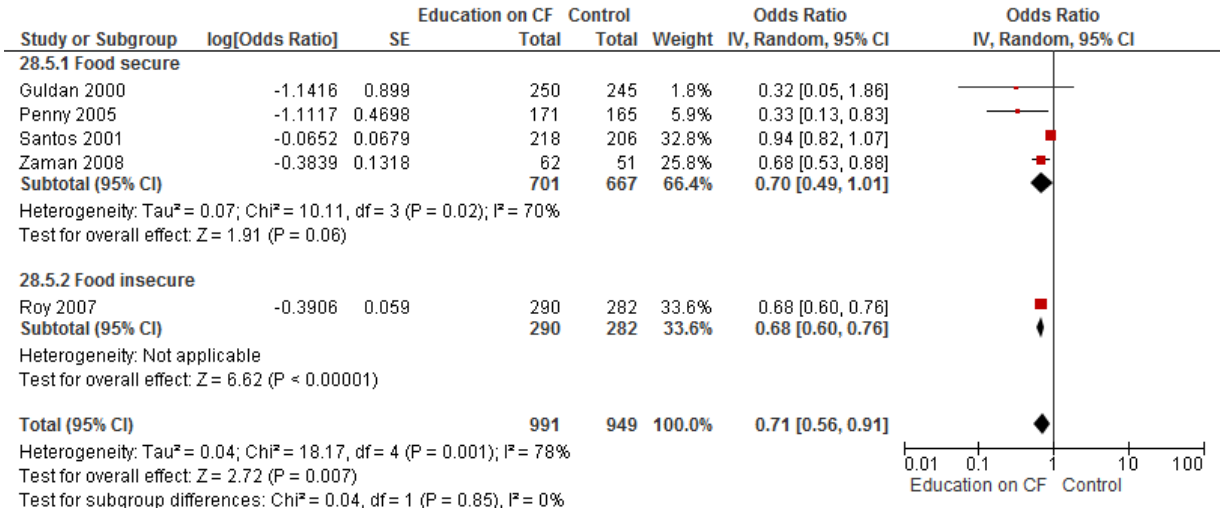
Study or Subgroup	Std. Mean Difference	SE	Education on CF Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
3.5.1 Food secure						
Guldan 2000	0.64	0.899	250	245	0.6%	0.64 [-1.12, 2.40]
Penny 2005	0.3702	0.1039	187	190	26.4%	0.37 [0.17, 0.57]
Santos 2001	0.0446	0.0972	218	206	28.6%	0.04 [-0.15, 0.24]
Zaman 2008	0.2461	0.1898	62	51	10.8%	0.25 [-0.13, 0.62]
Subtotal (95% CI)			**717**	**692**	**66.4%**	**0.22 [0.01, 0.43]**
Heterogeneity: Tau² = 0.02; Chi² = 5.53, df = 3 (P = 0.14); I² = 46%						
Test for overall effect: Z = 2.06 (P = 0.04)						
3.5.2 Food insecure						
Roy 2007	0.253	0.084	290	282	33.6%	0.25 [0.09, 0.42]
Subtotal (95% CI)			**290**	**282**	**33.6%**	**0.25 [0.09, 0.42]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 3.01 (P = 0.003)						
Total (95% CI)			**1007**	**974**	**100.0%**	**0.23 [0.09, 0.36]**
Heterogeneity: Tau² = 0.01; Chi² = 5.73, df = 4 (P = 0.22); I² = 30%						
Test for overall effect: Z = 3.32 (P = 0.0009)						
Test for subgroup differences: Chi² = 0.07, df = 1 (P = 0.80), I² = 0%						



Citation to the included studies:
Guldan 2000,[15] Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.3 Stunting (HAZ < -2)

As food secure/insecure

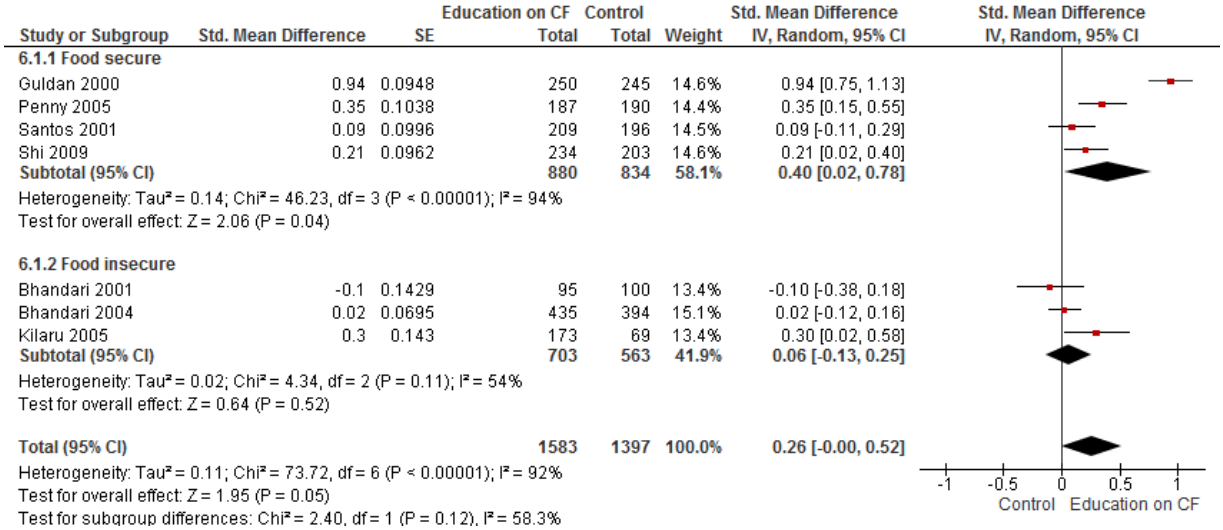


Citation to the included studies:

Guldan 2000,[15] Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.4 Weight Gain (kg)

As food secure/insecure

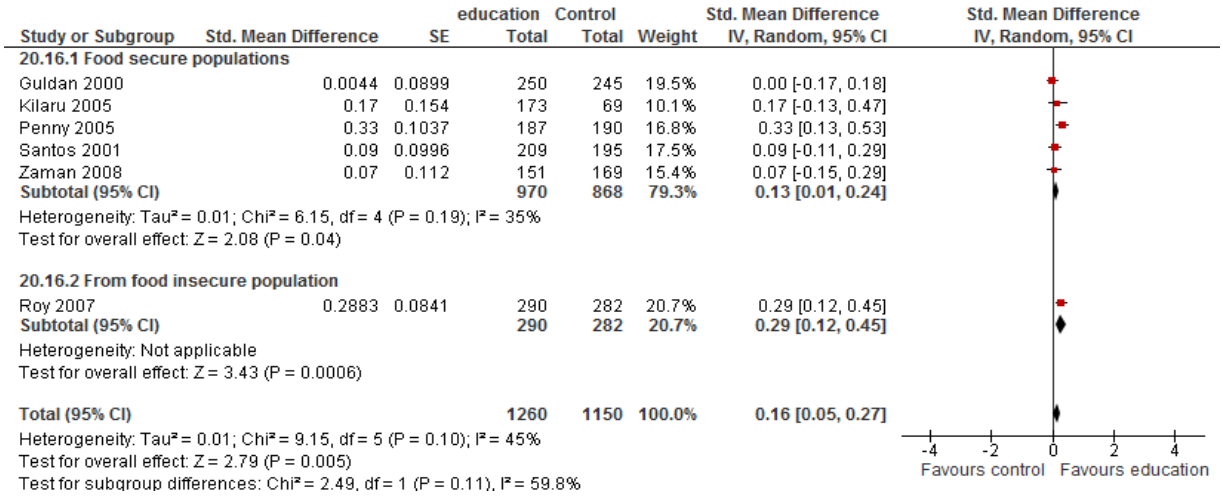


Citation to the included studies:

Bhandari 2001,[26] Bhandari 2004,[27] Penny 2005,[28] Santos 2001,[35] Shi 2009,[31] Guldan 2000,[15] Kilaru 2005[16]

1.5 Weight-for-Age (Mean Z Scores)

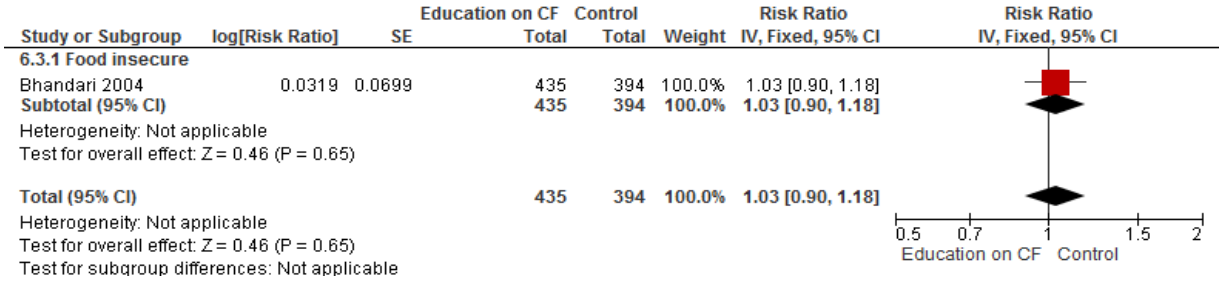
As food secure/insecure



Citation to the included studies:
Guldan 2000,[15] Kilaru 2005,[16] Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.6 Underweight (WAZ <-2)

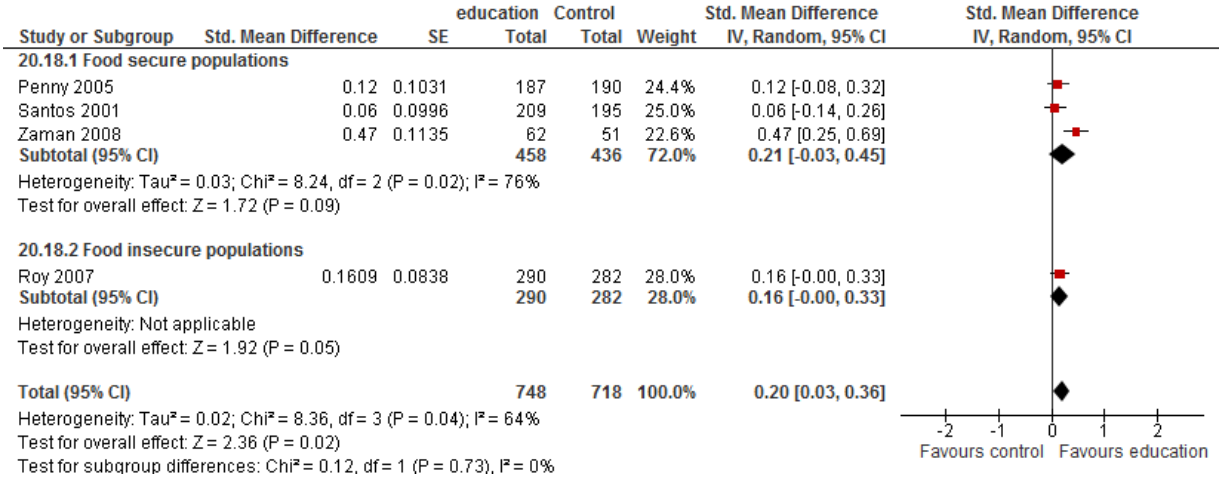
As food secure/insecure



Citation to the included study:
Bhandari 2004[27]

1.7 Weight-for-Height (Mean Z Scores)

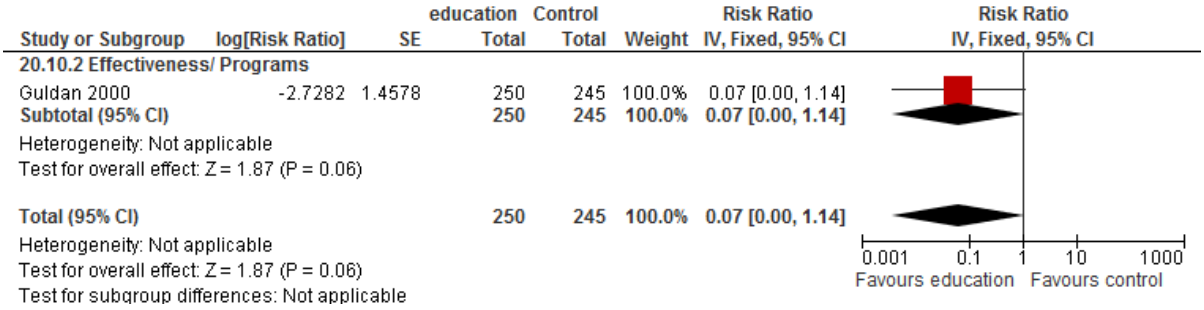
As food secure/insecure



Citation to the included studies:
Penny 2005,[28] Santos 2001,[35] Zaman 2008,[33] Roy 2007[39]

1.8 Wasting (WHZ <-2)

As food secure/insecure

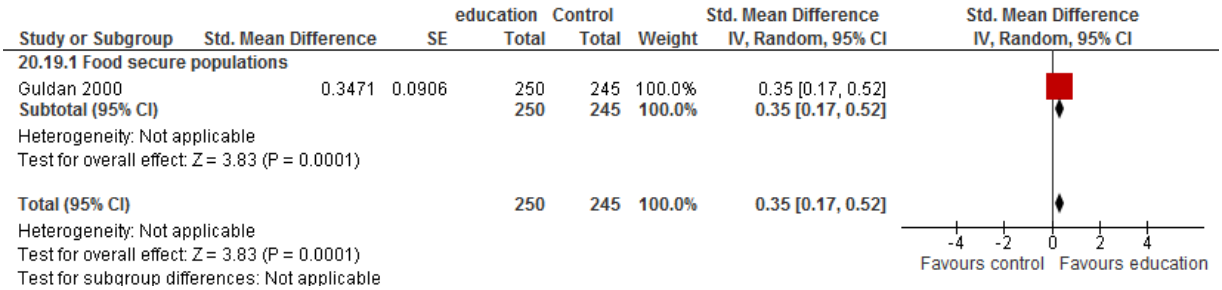


Citation to the included study:
Guldan 2000[15]

Haematological Measurements

1.9 Haemoglobin (g/L)

As food secure/insecure

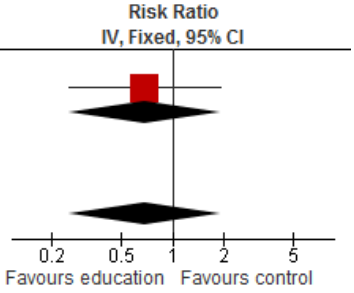


Citation to the Included Study:
Guldan 2000[15]

1.10 Anaemia (Hb <110 g/L)

As food secure/insecure

Study or Subgroup	log[Risk Ratio]	SE	Education Total	Control Total	Weight	Risk Ratio IV, Fixed, 95% CI
20.5.2 Effectiveness/ Programs						
Guldan 2000	-0.3696	0.5114	250	245	100.0%	0.69 [0.25, 1.88]
Subtotal (95% CI)			**250**	**245**	**100.0%**	**0.69 [0.25, 1.88]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.72 (P = 0.47)						
Total (95% CI)			**250**	**245**	**100.0%**	**0.69 [0.25, 1.88]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.72 (P = 0.47)						
Test for subgroup differences: Not applicable						



Citation to the included study:
Guldan 2000[15]

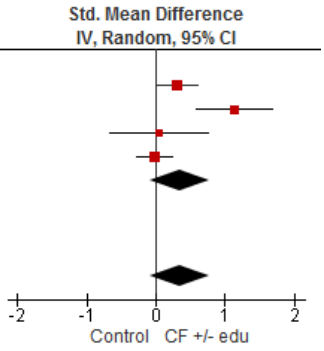
2.0 Complementary feeding plus education AND complementary feeding alone

Linear Growth

2.1 Height Gain (cm)

As food secure/insecure

Study or Subgroup	Std. Mean Difference	SE	CF +/- edu Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
5.2.1 Food insecure						
Bhandari 2001	0.31	0.146	97	93	29.7%	0.31 [0.02, 0.60]
Obatulo 2003	1.13	0.2794	30	30	22.2%	1.13 [0.58, 1.68]
Oelofse 2003	0.04	0.366	16	14	17.8%	0.04 [-0.68, 0.76]
Schroeder 2002	-0.02	0.1313	114	118	30.4%	-0.02 [-0.28, 0.24]
Subtotal (95% CI)			**257**	**255**	**100.0%**	**0.34 [-0.09, 0.78]**
Heterogeneity: Tau² = 0.15; Chi² = 14.57, df = 3 (P = 0.002); I² = 79%						
Test for overall effect: Z = 1.54 (P = 0.12)						
Total (95% CI)			**257**	**255**	**100.0%**	**0.34 [-0.09, 0.78]**
Heterogeneity: Tau² = 0.15; Chi² = 14.57, df = 3 (P = 0.002); I² = 79%						
Test for overall effect: Z = 1.54 (P = 0.12)						
Test for subgroup differences: Not applicable						

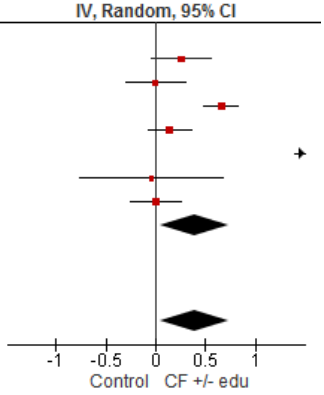


Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

2.2 Height-for-Age (Mean Z Scores)

As food secure/insecure

Study or Subgroup	Std. Mean Difference	SE	CF +/-edu Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
3.4.1 Food insecure						
Adu-Afarwuah 2007	0.2589	0.1512	97	81	15.3%	0.26 [-0.04, 0.56]
Bhandari 2001	0	0.1499	87	91	15.4%	0.00 [-0.29, 0.29]
Lartey 1999	0.6581	0.088	190	465	16.6%	0.66 [0.49, 0.83]
Lutter 2008	0.1407	0.1124	170	149	16.2%	0.14 [-0.08, 0.36]
Obatulo 2003	2.03	0.3216	30	30	10.9%	2.03 [1.40, 2.66]
Oelofse 2003	-0.04	0.366	16	14	9.8%	-0.04 [-0.76, 0.68]
Schroeder 2002	0	0.1313	114	118	15.8%	0.00 [-0.26, 0.26]
Subtotal (95% CI)			**704**	**948**	**100.0%**	**0.39 [0.05, 0.73]**
Heterogeneity: Tau² = 0.18; Chi² = 57.04, df = 6 (P < 0.00001); I² = 89%						
Test for overall effect: Z = 2.23 (P = 0.03)						
Total (95% CI)			**704**	**948**	**100.0%**	**0.39 [0.05, 0.73]**
Heterogeneity: Tau² = 0.18; Chi² = 57.04, df = 6 (P < 0.00001); I² = 89%						
Test for overall effect: Z = 2.23 (P = 0.03)						
Test for subgroup differences: Not applicable						

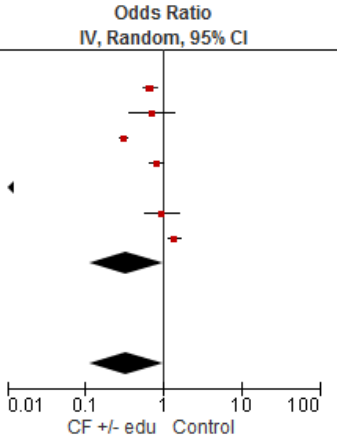


Citation to the included studies:
Oelofse 2003,[42] Adu-Afarwuah,[17] Bhandari 2001,[26] Lartey 1999,[20] Lutter 2008,[21] Obatulo 2003,[41] Schroeder 2002[43]

2.3 Stunting (HAZ <-2)

As food secure/insecure

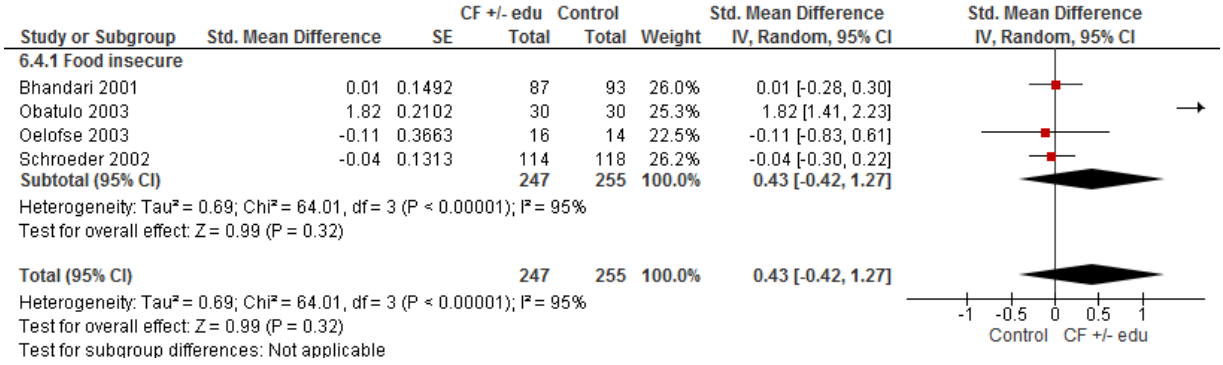
Study or Subgroup	log[Odds Ratio]	SE	CF +/- edu Total	Control Total	Weight	Odds Ratio IV, Random, 95% CI
4.4.1 Food insecure						
Adu-Afarwuah 2007	-0.4	0.105	97	81	14.4%	0.67 [0.55, 0.82]
Bhandari 2001	-0.3446	0.3371	87	91	13.8%	0.71 [0.37, 1.37]
Lartey 1999	-1.1813	0.055	190	465	14.5%	0.31 [0.28, 0.34]
Lutter 2008	-0.21202	0.1124	170	149	14.4%	0.81 [0.65, 1.01]
Obatulo 2003	-5.809	0.181	30	30	14.3%	0.00 [0.00, 0.00]
Oelofse 2003	-0.0535	0.255	16	14	14.1%	0.95 [0.58, 1.56]
Schroeder 2002	0.322	0.092	114	118	14.5%	1.38 [1.15, 1.65]
Subtotal (95% CI)			**704**	**948**	**100.0%**	**0.33 [0.11, 1.00]**
Heterogeneity: Tau² = 2.15; Chi² = 1011.49, df = 6 (P < 0.00001); I² = 99%						
Test for overall effect: Z = 1.96 (P = 0.05)						
Total (95% CI)			**704**	**948**	**100.0%**	**0.33 [0.11, 1.00]**
Heterogeneity: Tau² = 2.15; Chi² = 1011.49, df = 6 (P < 0.00001); I² = 99%						
Test for overall effect: Z = 1.96 (P = 0.05)						
Test for subgroup differences: Not applicable						



Citation to the included studies:
Oelofse 2003,[42] Adu-Afarwah,[17] Bhandari 2001,[26] Lartey 1999,[20] Lutter 2008,[21] Obatulo 2003,[41] Schroeder 2002[43]

2.4 Weight Gain (kg)

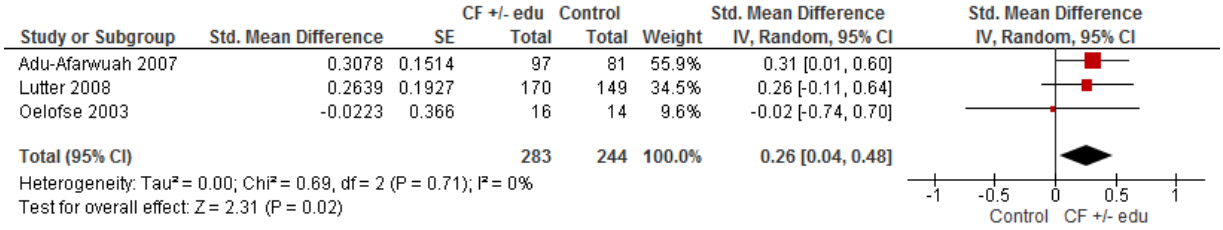
As food secure/insecure



Citation to the included studies:
Bhandari 2001,[26] Oelofse 2003,[42] Schroeder 2002,[43] Obatulo 2003[41]

2.5 Weight-for-Age-Z Scores

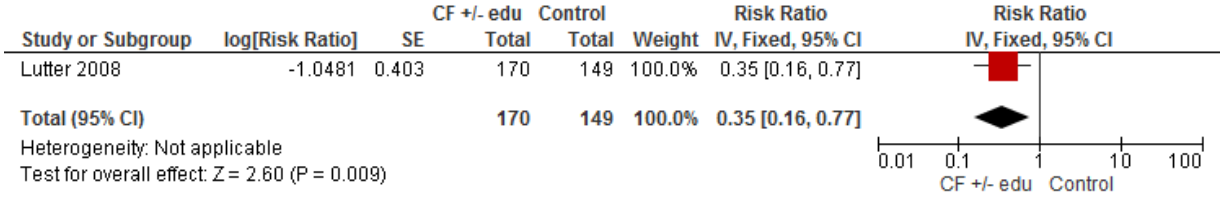
As food secure/insecure



Citation to the included studies:
Adu-Afarwuah 2007,[17] Lutter 2008,[21] Oelofse 2003[42]

2.6 Underweight (WAZ <-2)

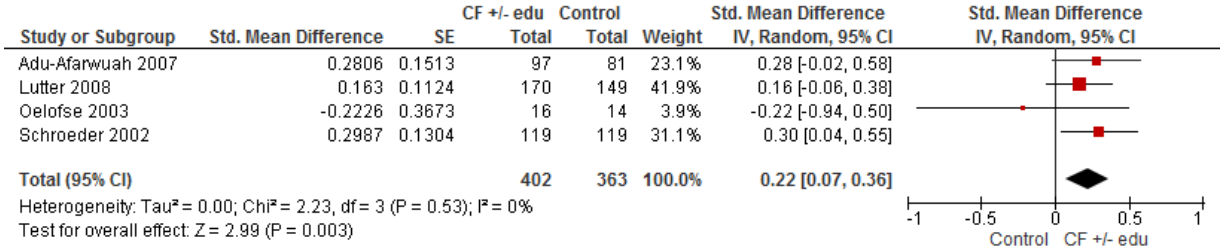
As food secure/insecure



Citation to the included study:
Lutter 2008[21]

2.7 Weight-for-Height (Mean Z Scores)

As food secure/insecure

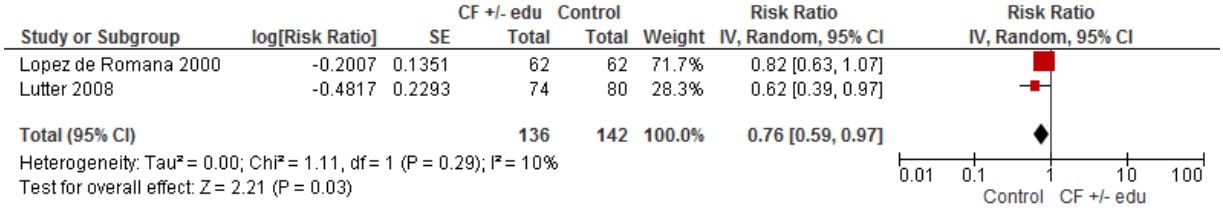


Citation to the included studies:
Adu-Afarwuah 2007,[17] Lutter 2008,[21] Oelofse 2003,[42] Schroeder 2002[43]

Hematological Outcomes

2.15 Anaemia Prevalence (Hb<110g/L)

2.15.1 Effectiveness trials from food secure population

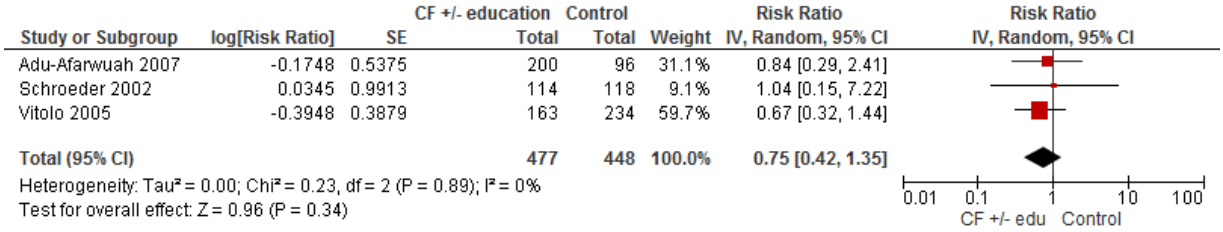


Citation to the included studies:
Lopez de Romana 2000,[18] Lutter 2008[21]

Complementary food or education on complementary food

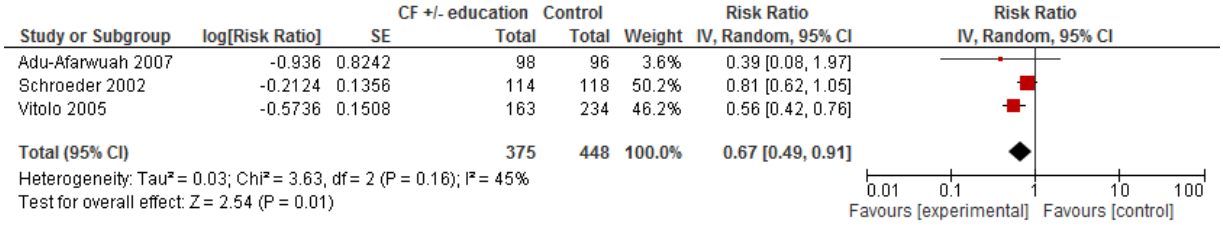
5. Morbidity Outcomes

3.1 Diarrhoea



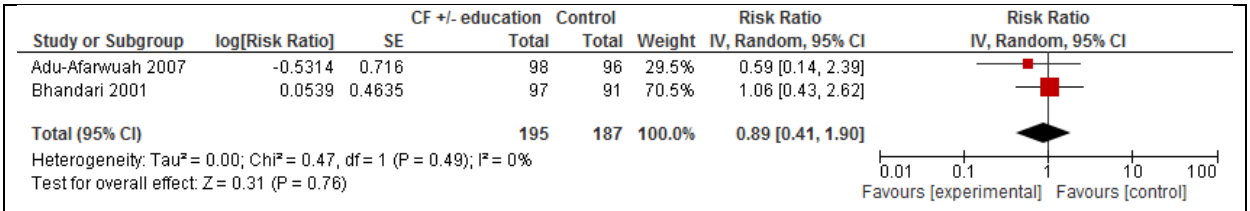
Citation to the included studies:
Adu-Afarwuah,[17] Vitolo 2005,[32] Schroeder 2002[43]

Acute respiratory infections



Citation to the included studies:
Vitolo 2005,[32] Schroeder 2002,[43] Adu-Afarwuah[17]

Fever



Citation to the included studies:
Adu-Afarwuah 2007,[17] Bhandari 2001[26]