EFFECTIVENESS OF NUTRITION INTERVENTIONS IN LOW AND MIDDLE INCOME COUNTRIES: A SYSTEMATIC REVIEW

OVERVIEW OF REVIEW OF SYSTEMATIC REVIEWS, [JANUARY, 2018]

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Conflicts of interest

None declared

Use of maps

Maps used in this report serve a purely descriptive purpose. The representation of political boundaries in the maps do not necessarily reflect the position of the Government of UK.

Contributions

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EXECUTIVE SUMMARY

BACKGROUND

Undernutrition remains as a major challenge for the majority of the low and middle-income countries (LMICs). Multiple nutrition interventions have been implemented globally, especially in LMICs to improve the health and nutrition status of the vulnerable and/or socio-economically disadvantaged populations. A number of indicators have been used to measure the impact of these interventions. The objective of this evidence summary was to summarise the findings from the selected Systematic Reviews (SRs) on the effectiveness of nutrition interventions (i.e. nutrition-specific and nutrition-sensitive) that have been implemented in LMICs on the World Health Assembly (WHA) global nutrition targets: reductions in the prevalence of stunting and wasting in under five children; decrease in the prevalence of anemia in woman of reproductive age; reduction in the prevalence of low birthweight (LBW) babies; and an increase the rate of exclusive breastfeeding in the first six months of life (WHO, 2014).

METHODS

We conducted a meta-review of all SRs to meta-synthesise the evidence on the effectiveness of nutrition interventions in LMICs towards achieving the outcomes as specified by the WHA global nutrition targets. Following a comprehensive search of varied topic specific databases, we screened titles, abstracts and full texts using a two stage double blind screening process. Quality and characteristics of SRs were considered during the evidence summary process. The included articles were appraised for quality using the standard AMSTAR tool. A total of 61 SRs was identified for the synthesis of the present meta-review. Based on the scores from the AMSTAR tool for each review, most SRs were judged to be of either high (n=34) or medium quality (n=22), with only 5 reviews of low quality. Extracted data from the included SRs were synthesised to examine the impact and direction of impact of nutrition interventions.

SUMMARY CONCLUSION

The primary WHA targets of interest for the meta-review were reduction in the rates of LBW babies (39%); reduction in the prevalence of stunting (34%) and wasting (29.5%) in children; reduction in the prevalence of anaemia in women of reproductive age (26%); and increase in the rates of exclusive breastfeeding (10%).

Review-level evidence on the impact of nutrition programmes on the WHA target outcomes in LMICs revealed a complex picture, with some interventions more successful than others in achieving their intended outcomes. For example, while there was an evidence of impact of iron supplementation with or without folic acid, wheat flour fortification with iron, and supplementation of Vitamin A or carotenoids on the reduction of anaemia among women of reproductive age, there was no evidence of similar impact for supplementation of multiple micronutrients, calcium or folic acid. Furthermore, there was no evidence of impact from agricultural interventions or cash transfer programmes on anemia. The evidence from nutrition

interventions showed an impact for Kangaroo care and community or peer supported programmes on early initiation of breastfeeding. Dietary interventions using a combination of education, food and fortified foods showed evidence of impact on low birthweight; dietary diversity and complementary feeding with education showed evidence of impact on stunting and nutrition education on appropriate complementary feeding practices showed evidence of impact on stunting and wasting. However, the evidence on the effect of a combination of child development and nutrition interventions on wasting appeared to be inconclusive.

KEY FINDINGS

The included SRs provided evidence on a range of nutrition interventions, delivered to women during pregnancy or directly to children in LMICs. The summary of evidence drawn from the present meta-review (Table 1 and Table 2) related to each of the WHA targets that are presented below; before reflecting on these findings and drawing implications for policy and practice.

Table 1: Nutrition interventions targeting pregnant women

Outcomes	Summary findings on impact	
	Evidence of impact	No evidence of impact
Anaemia	Supplementation of ● Iron fortified foods ● Iron supplements (with or without folic acid) ● Vitamin A and Carotenoids	Supplementation of/ fortification with ● Calcium ● Folic acid ● Multiple micronutrient
LBW	● Dietary intervention and maternal supplementary feeding ● Multiple micronutrient supplementation/ fortification ● Vitamin D Supplementation	Supplementation ● Calcium ● Folic acid ● Iron ● Magnesium ● n-3 LCPUFA ● Vitamin A and Carotenoids ● Vitamin C and E or ● Zinc
Exclusive breastfeeding	● Community interventions for the promotion of EBF ● Kangaroo mother care for pre-term babies ● Peer group led breastfeeding programs	

IMPLICATIONS FOR POLICY & PRACTICE

Anaemia: In LMICs where anaemia remains as a major public health challenge in women of reproductive ages, the existing anaemia control programmes should be strengthened with an

emphasis on interventions such as supplementation with iron fortified foods; Vitamin A and Carotenoids supplementation and iron supplementation for pregnant women. In LMICs where iron supplementation and food fortification programmes are unavailable or sparse, supplementation of iron with or without folic acid could be introduced or up-scaled with provisions in accordance with internationally standardised guidelines (such as the WHO guidelines). Such programmes should focus on effective implementation strategies including availability, timely distribution and monitoring the consumption of these tablets. In populations where dietary intakes of Vitamin A /carotenoids are low, supplementation of Vitamin A might support reducing the prevalence of anaemia. Vitamin A deficiency influences in the absorption and utilisation of iron; thus, correction of Vitamin A deficiency may improve the utilisation of iron in the body (Michelazzo et al., 2013). This approach should be considered with caution for pregnant women as a large dose supplementation of Vitamin A in first trimester could have adverse effects on the fetus (WHO, 1998; Cruz et al., 2017).

Low Birthweight: The existing IFA supplementation could be expanded to multiple micronutrients including Vitamin D in LMICs where substantial proportion of pregnant women have multiple micronutrient deficiencies or have poor intakes of micronutrients. The health programmes should include dietary intervention strategies such as dietary diversification together with nutrition education to optimise the use locally available foods which, improve the nutrient intakes and to support optimal weight gain during gestation. In HIV positive women supplementation of Vitamin A had significant effect in reducing LBW.

Exclusive Breastfeeding: Community based and peer-led interventions could be used as a strategy for the implementation of interventions to promote breastfeeding. Such programmes could focus on pregnant women prior to and immediately after delivery, and during the first six months of infant age. A community-based peer support system would be a less resource intensive, feasible for promotion of exclusive breastfeeding. Additionally, implementation and integration of Kangaroo Mother Care (KMC) programme as a part of the healthcare programme post-delivery at the health facility level may promote exclusive breastfeeding rates. Community-based peer led groups could support the new mothers through timely, adequate, nutritious, responsive and appropriate complementary feeding programme for infants >six months until two years.

Table 2: Nutrition interventions targeting children

Outcomes	Summary of findings	
	Evidence of impact	No evidence of impact
Stunting	Dietary diversity and complementary feeding practices	• Agricultural interventions • Cash transfer • Combined interventions • Iron supplementation • Multiple micronutrient fortification/supplementation

		• Prevention and treatment of acute malnutrition • WASH • Zinc supplementation
Wasting	Nutrition education on complementary feeding practices (Mixed impact)	• Agricultural interventions • Combined interventions • Iron supplementation • Multiple micronutrient fortification/supplementation • Supplementary feeding • WASH • Zinc supplementation

Stunting: Targeted efforts to promote dietary diversity; timely and adequate introduction of nutritious, locally prepared complementary foods, and follow-up of complementary feeding practices during early childhood through nutrition counselling are essential, especially in low resource settings of LMICs to reduce stunting prevalence (acute and chronic malnutrition).

Wasting: Wasting should be prevented in normal children and treated if children are malnourished and subsequently should be supported with adequate nutrient rich foods to sustain their growth and development. Continued supplies of nutrients are important to improve the nutritional status and to prevent wasting in young children. Nutrition education to improve complementary feeding practices, programmes addressing wasting in infants post breastfeeding and subsequently in young school children through improved nutrient intakes via school feeding programmes might strengthen using nutrient-rich snacks and beverages.

RESEARCH GAPS

- The SRs that considered the effectiveness of nutrition interventions on the selected WHA targets for the urban and semi-urban settings showed inconclusive results, thus, more studies specifically focussed to the urban settings are needed to strengthen the evidence for policy development for these populations.
- Impact and effectiveness of community-based dietary diversification strategies using locally available nutritious foods to improve the health and nutritional status of women and children need to be ascertained.
- There is a paucity of recommendations on the food based dietary strategies for different regions and LMICs. Emphasis could be placed to develop food based dietary recommendation strategies, especially for women of reproductive age and under five children to address the WHA targets.
- Impact of empowering communities to address the nutritional challenges of women (anemia and low birthweight) and children (especially SAM and MAM) using the locally available and low-cost food sources could be evaluated.

- Combinations of nutrition-specific and nutrition-sensitive approaches to improve the nutritional status of women and young children sustainably should be evaluated.
- The role of household food security on dietary diversification strategies, health and nutritional status of women and children could provide insights into the need for fortification and supplementation for communities.

1. BACKGROUND

Undernutrition remains as a major challenge for most of the low and middle-income countries (LMICs). Undernutrition, as defined by the UNICEF, is the outcome of insufficient food intake and repeated infectious diseases (UNICEF, 2016), which includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) and deficient in vitamins and minerals (micronutrient malnutrition). Undernutrition affects all segments of the population in LMICs, with some groups such as children, adolescent girls, women of reproductive age, elderly and the socio-economically disadvantaged being particularly vulnerable. Risk factors of undernutrition are complex and range from the wider socio-economic and political determinants to individual specific factors that interact in different ways throughout the life course (Scaling up of Nutrition, 2011). The UNICEF conceptual framework suggests that aetiology of undernutrition is multifactorial, complex and intricate.

Undernutrition can have adverse effects on health and well-being throughout the life course and has been considered as a leading cause of death, disability, and ill-health (WHO, 2013). For example, maternal short stature and underweight have been associated with fetal growth restriction that contributes to about 12% of all neonatal deaths (Black et al., 2008). Being underweight makes infants and mothers susceptible to infections and delays recovery. Repeated bouts of infectious diseases are estimated to cause 3.1 million preventable maternal and child deaths annually (Black et al., 2013). Deficiencies in iron, iodine, zinc and vitamins are shown to lead to problems such as brain damage, blindness, anaemia, and stunted growth. Also, poor nutritional status tends to affect learning abilities in childhood, and undernutrition can lead to the delayed achievement of developmental milestones in children and subsequently poor achievements in adulthood (Hoddinott, 2013).

It is universally accepted that adverse effects of undernutrition including the resultant morbidity and mortality can be prevented through timely intervention programmes. Nutrition programmes refer to interventions that seek to improve the nutritional status of the population. It has been shown that scaling up of nutrition interventions can be hugely beneficial to millions of populations in LMICs (Bhutta et al., 2013). For example, examining maternal and child health interventions implemented in 34 countries, (Bhutta et al., 2013) have ascertained that deaths in children younger than five years can be reduced by 15% by scaling up various nutrition interventions (Bhutta et al., 2013).

Multiple nutrition interventions have been implemented globally, especially in LMICs to improve health and nutrition status of the vulnerable and/or socio-economically disadvantaged populations. Nutrition interventions are primarily targeted at improving the nutritional status of populations through augmenting the dietary intake to achieve the optimal/desirable intake of various nutrients. These interventions have been classified broadly into nutrition-specific interventions and nutrition-sensitive interventions. Nutrition-specific interventions address the immediate causes of undernutrition including dietary intake, feeding practices and access to food. Nutrition-specific interventions may involve direct supplementation of various nutrients (e.g., calcium, iron, folic acid, vitamin A, zinc, iodine) to prevent nutrient deficiencies in populations. Nutrition-sensitive interventions address the underlying causes of undernutrition

or malnutrition by incorporating actions from a wide range of sectors (agriculture, public health, education, etc.) Most nutrition-sensitive programmes involve improving food availability and food consumption, and increasing dietary diversity to support adequate food intake, to ensure appropriate nutrient intake among vulnerable populations. A number of indicators have been used to measure the impact of these interventions as reported in the later sections.

Rationale for conducting an evidence summary

Evidence summaries harvested from the existing systematic reviews (SRs) and meta-analyses help to consolidate the available evidence in a specific area to support evidence-based policy formulation and implementation of programs. Additionally, such summaries provide insights into the availability/non-availability of the existing evidence and quality of the evidence in a particular theme or area of research.

As mentioned before, a large number of nutrition programmes exist in LMICs and the impact of these interventions has been largely positive overall, however, many programmes have had inherent challenges at the implementation and uptake levels. On the other hand, issues related to undernutrition still persist in many LMICs, especially in South Asia and sub-Saharan Africa. This urges the need for a more informed approach in national and international nutrition policies and programmes and calls for collaborative action at various levels involving international agencies, donors, civil societies and private sectors (Das, 2016). The objective of this evidence summary is to summarise available SRs on different types of nutrition programmes and interventions that have been implemented in LMICs, especially in South Asia. Focusing on the WHA global nutrition targets that are presented in detail below, the evidence summary will draw out learning regarding the effectiveness of different nutrition-enhancing interventions, key challenges faced and South Asia specific factors that determine the success or failure of such programmes.

The Global Nutrition Targets

The WHA specified a set of six global nutrition targets that are to be achieved by 2025. These targets include: reduction in the prevalence of stunting and wasting among young children; reduction in prevalence of low birthweight (LBW) babies; reduction of anaemia among women of reproductive age, reduction in the prevalence of overweight and increase the rate of exclusive breastfeeding until first 6 months of life (WHO, 2014). As the scope of the present review focused only on the targets that are related undernutrition in LMICs, the sixth indicator (overweight and obesity) was not considered for the meta-review synthesis.

Target 1: Reduction of stunting among young children

Stunting represents chronic malnutrition in children as reflected from their low height/length-for-age z-score (below -2SD of WHO/NCHS reference median value); and a height/length-for-age z-score below -3SD indicates severe stunting (WHO Multicentre Growth Reference Study Group, 2006). Stunting often impairs early childhood growth and development in children and leads to poor cognition and suboptimal school performance (Walker et al., 2007). Although the rate of stunting gradually declined since the year 2000, around 156 million children aged less than five years globally remains stunted. Asia was the home for more than half (56%) of all stunted under-five children, while Africa shared more than one-third (37%) (UNICEF, WHO & World Bank, 2016).

The WHA set the target to have 40% reduction in the number of stunted children aged less than five years by 2025 (WHO, 2014).

Target 2: Reduction of anaemia among woman of reproductive age

Anaemia, a pathological condition, results when the concentration of haemoglobin in blood declines below the established cut-off value resulting in decreased transport of oxygen throughout the body (Hoffbrand et al., 2011). Although anaemia can occur at any stage of life, women of reproductive-age are particularly susceptible (WHO/CDC, 2008). According to the WHO cut-off points, non-pregnant women are considered anaemic with a blood haemoglobin level less than 12 g/dl and severely anaemic with a value less than 8 g/dl. Pregnant women are considered anaemic when the haemoglobin level falls below 11 g/dl and severely anaemic with a value less than 7 g/dl (WHO 2011). Anaemia can lead to impaired immunity and reduced working capacity among reproductive-age women. Anaemic pregnant women are at an increased risk for premature delivery, and severe anaemia during gestation results in low birthweight (LBW) children (birthweight <2.5 kg), infant mortality and morbidity (Arses, 2014). Globally, 29.4% of the women of childbearing age are estimated to suffer from anaemia with a prevalence of 31.4% among women from LMICs (Stevens et al. 2013). The WHA targets 50% reduction of anaemia among women of reproductive age (WHO, 2014).

Target 3: Reduction in the prevalence of low birthweight (LBW) babies

Low Birthweight Babies (LBW) have a birthweight of less than 2500 grams and Very Low Birthweight (VLBW) have a birthweight less than 1500 grams. LBW and VLBW result either from intrauterine growth retardation or preterm delivery (delivery before 37 weeks of gestation) or a combination of both (WHO, 2017). LBW babies have increased risk of mortality and morbidity during infancy, and are susceptible to restricted physical growth, cognitive and neural development, and increased chances of chronic diseases in the later part of their life (Baker, 1992). About 16% of newborn comprising of approximately 22 million babies were born as LBW globally (2013). The majority of the LBW babies (28%) were concentrated in South Asian countries, followed by the West and Central Africa (14%) (UNICEF, 2016). The WHA has accorded significant importance in addressing this issue and set a target of 30% reduction in the prevalence of LBW by the year 2025 (WHO, 2014).

Target 4: Increase the rate of exclusive breastfeeding in the first 6 months

Exclusive breastfeeding for babies could be defined as feeding breast milk solely to the infant during the first 6 months of life (Jones et. al., 2003). Breastfeeding is crucial for child survival as it ensures the adequate supply of all the necessary nutrients required for the growth and development of babies. Also, breastfeeding protects the child from diarrhoea and provides immunity from other life-threatening disorders and non-communicable diseases in the later period of life (Horta et. al., 2014). Estimates suggest that 38% infants aged 0 to 6 months are exclusively breastfed and that suboptimal feeding practices contribute to 11.6% mortality among under-five children (Black et. al., 2013). The WHA has set up the target of an increase in exclusive breastfeeding rates up to at least 50% by 2025 (WHO, 2014).

Target 5: Reduction in the prevalence of wasting among young children

Wasting, defined as weight-for-height z-score below -2SD of WHO/NCHS reference median value, represents an acute form of malnutrition from nutritional deprivation resulting in severe weight loss. Children are considered severely wasted if weight-for-height z-score declines below -2SD (WHO Multicentre Growth Reference Study Group, 2006). Wasting has serious health consequences in infants and young children with increased susceptibility to infectious diseases and in severe cases for increased mortality (Ricci and Stan, 1996). Globally, in 2016, the prevalence of wasting and severe wasting in under five-children was estimated to be 7.7% and 2.7%, respectively. The prevalence was highest in LMICs with estimates ranging between 15% and 20% (UNICEF 2017). The WHA target of wasting was two-fold – both reducing to and maintaining the global prevalence of wasting among under-five children at 5% by 2025 (WHO, 2014).

Variations from the original RFP:

The original RFP was proposed to investigate the effectiveness of nutrition interventions in LMICs with respect to the nutritional status of general and socio-economically disadvantaged populations across the lifecycle. The literature search via multitude electronic databases yielded a several SRs and the synthesis of the present evidence summary needed considerably longer time frame and efforts. In this scenario, our advisory group suggested to segregate the SRs based on the WHA targets that focus on the pressing nutritional challenges in the LMICs. The aforementioned approach would be more relevant and useful to the policy makers to address the key nutritional issues with a set of targets to be achieved by 2025. Furthermore, there have been more evidence available on the WHA targets in the recent years, which could strengthen the existing approaches to achieve the set WHA targets through evidence based informed policy decisions. Therefore, the present evidence summary was realigned to summarise nutrition interventions for five WHA targets namely- reduction in the rates of wasting, stunting, low birthweight, anaemia and increase in the exclusive breastfeeding rates. Out of the six WHA targets, reduction in the prevalence of overweight and obesity was not considered in this evidence summary as this was out of the purview of the original RFP (i.e. original RFP focused on the nutrition interventions for alleviating undernutrition in LMICs).

Research aims and review questions

Based on the framework above, the aim of this meta-review was to identify, critically appraise and provide an overview of review-level evidence on the effectiveness of nutritional interventions delivered in LMICs targeted at the WHA specified outcomes. This meta-review addresses the following primary research question and the sub questions:

a) Primary question:

What review-level evidence exists on the effectiveness (in terms of achieving the outcomes as specified by WHA) of nutrition interventions in LMICs?

b) Sub-questions:

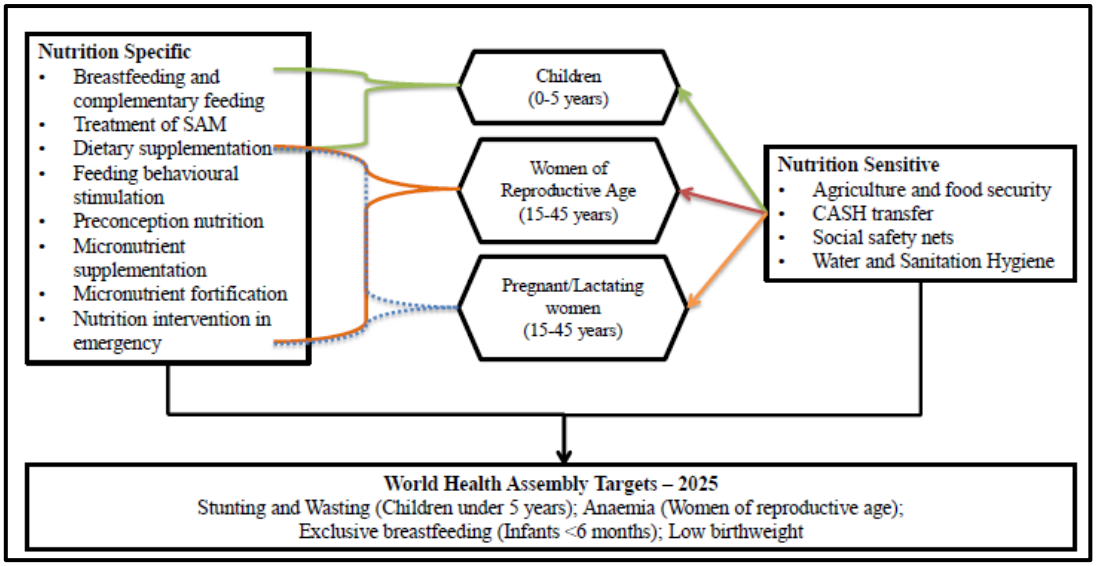
a) What types of nutrition interventions are shown to be effective in improving the outcomes specified by WHA?

b) What review-level evidence exists on the factors potentially contributing to the success or failure of these interventions in LMICs?

c) Are there review-level evidence of effectiveness of nutrition interventions specific to urban settings in LMICs? If so, what are the key characteristics of successful nutrition intervention programs delivered in urban settings?

CONCEPTUAL FRAMEWORK

The conceptual framework for the present evidence summary on nutrition interventions for LMICs realigned to the WHA targets is presented below while that of the original RFP is presented in Appendix I.



2 METHODS

Review approach

The present review was conducted as a part of "Training evidence summary" supported by the South Asian Research Hub (SARH), a Systematic Review Programme for South Asia. The original aim of the meta-review was to develop an evidence summary on the effectiveness of nutrition interventions for policy-makers to support evidence-based policy making towards addressing the nutritional challenges in LMICs. The aim of the meta-review was later refined following discussions with the advisory group (stated in section 2.1). The team received special training (residential and online) on 'Systematic Review and Evidence Summary Synthesis' with support from LIRNEAsia (capacity building partner), and the EPPI-Centre (quality assurance partner). An advisory group consisting of subject and methodology experts was set up at the initial stage of the review. The title of evidence summary was registered with the EPPI-Centre followed by developing a research protocol.

Review team and advisory group

A multidisciplinary review team and advisory group *(Appendix II)* comprising of subject and methodology experts was set up. We engaged with the advisory group throughout the review process via emails, telephone and Skype to obtain their advice and feedback in identifying relevant reviews, quality appraisal, data extraction tool, advice on evidence synthesis and final report writing. Also, the advisory group members provided support in enhancing our contextual understanding of nutrition interventions in South Asia particularly Bangladesh. We invited them to comment on the draft protocol by email and held one face to face meeting to discuss initial findings from included studies and to seek feedback on the synthesis process. Following the suggestions from the advisory group, to prioritise the evidence synthesis on the WHA undernutrition targets set for 2025 these targets were chosen as the intended outcomes for the present evidence summary synthesis (please see the section 2.1 for a detailed discussion presented in the previous sections).

Setting Inclusion/exclusion criteria

Based on the research questions, we developed a set of inclusion and exclusion criteria. Inclusion/exclusion criteria were required for two different purposes: Firstly, search results were screened using an initial set of exclusion criteria to narrow down the results. Secondly, a detailed list of inclusion criteria was used to screen the full-text articles. Both the criteria were coded in the EPPI-Reviewer for a two-stage screening process (as explained below).

Initial exclusion criteria

We started narrowing our results by applying 'language' as first criteria to exclude irrelevant SRs. All those articles published in English were then looked for 'date of publication', which was set between Jan 2000 and June 2016. Subsequently, non-systematic reviews were excluded. Later, abstracts of the articles were read and based on the exclusion criteria for population and intervention, SRs that are not relevant to the present evidence summary were excluded. (The initial exclusion criteria for the present evidence summary are appended in Appendix III). The report focussed on WHA targets hence therapeutic interventions were excluded in the screening stage.

Detailed inclusion criteria: Full text SRs were screened using a detailed set of inclusion criteria and were coded in the EPPI-Reviewer which is a comprehensive online software tool for research synthesis (https://eppi.ioe.ac.uk/CMS/Default.aspx?alias=eppi.ioe.ac.uk/cms/er4&). SRs were included if the authors have searched at least two databases and synthesised primary evidence to assess the effectiveness of nutrition interventions in LMICs with respect to the WHA targets. We included SRs if they focused on the nutrition specific and/or sensitive interventions pertaining to the WHA targets. Lastly, we applied 'outcome' as inclusion criteria and included all SRs broadly aiming to reduce wasting, stunting, anaemia, LBW and increase exclusive breastfeeding rates. We have included those narrative reviews which followed systematic review methodology not necessarily synthesised statistically.

Identifying reviews

Database search

We conducted a comprehensive electronic search on a range of international and regional databases dealing with topics on nutrition, health and social science, public health, systematic review (published and grey literature), and included 21 databases (Appendix IV).

Search strategy

Search terms (Appendix V) were developed using controlled and free text vocabulary. Three concepts (interventions, context and study design) were used to identify relevant reviews. Search terms were developed for each concept and a comprehensive search strategy (Appendix VI) was developed for each database with support from our librarian with expertise in systematic review searches. The searches were run for individual databases using filters such as date of publication and type of study design. Results of initial hits of searching various databases together with the employed strategy are provided as Appendix VI.

Importing searches to the EPPI-reviewer

Database searches were imported in RIS (Research Information System) format (used Google scholar to get RIS format of searched SRs) to the EPPI-Reviewer 4 developed by the EPPI-centre, UK. The EPPI-Reviewer is a software used to facilitate the evidence summary process including screening, quality appraisal, data extraction and synthesis of summary. Duplicate reviews (n=1542) were removed before identifying SRs for screening process.

Double blinded review process

Initial database searches yielded a large number of systematic reviews for nutrition interventions; hence, work was allocated to two teams consisting of two independent reviewers per group. Individual members of each team followed blinded review process for screening, quality appraisal and data extraction. All these processes were conducted on the EPPI-Reviewer by developing code sets in the software, which enabled reviewers to independently perform the allocated task. In cases of a discrepancy, a third investigator attached to the two teams (SP, KM) reconciled the differences and final decision was made.

Screening

Following initially a two-stage screening process was adopted to select eligible SRs based a set of inclusion and exclusion criteria based on the review questions as appended in Appendix III. SRs were included if the authors have searched at least two databases and synthesised primary evidence to assess the effectiveness of nutrition interventions in LMICs.

First stage: Initially, titles and abstracts of the identified reviews were screened and 833 articles were included for Stage 2 screening. An attempt was made to retrieve full texts of all selected systematic reviews included on the basis of the title and abstract screening, though a few full-texts of articles were not accessible. So such reviews were excluded from the evidence synthesis (n=28: withdrawn/old version/electronic version not available/no access to full text).

Second stage: The full-texts that had been retrieved based on the title and abstract screening were further filtered based on an additional set of inclusion criteria (Appendix-VI). The selected SRs were included for the evidence summary synthesis (n=134).

Third stage: A large number of SRs were identified for the evidence summary synthesis, which was beyond the scope and time limits of the proposed RFP. The results of the screening were presented in the advisory group meeting and it was advised that to realign the review to the WHA targets to be achieved by 2025. In order to identify the SRs that solely addressed wasting, stunting, anaemia, LBW and exclusive breastfeeding, further screening was performed and identified SRs (n=61) for the evidence summary synthesis. Finally 61 SRs were included.

Quality appraisal and data extraction

The included full-text SRs were appraised for methodological quality using the AMSTAR tool (Shea et al., 2007) provided in Appendix VII. The AMSTAR tool was used to appraise the quality of SRs considering methodology adopted in conducting the present review where SRs were harnessed to synthesise evidence. Reviews were assessed based on an eleven point criteria and the individual scores were summed to obtain the total scores (within a range of 0 to 11). The quality of SRs was classified as low (scores 0 to 3), medium (scores 4 to 7), and high (scores 8 to 11) based on the total scores obtained from the AMSTAR tool. The qualities of included reviews are indicated in the table before write-up of result for each WHA target.

The data were extracted (or 'coded') using a data extraction tool. The team of methodological and subject experts developed the extraction tool to gather relevant information to address research questions. The tool was tested using a few random studies for its appropriateness and was modified accordingly. Codes prepared from the tool broadly included details related to context, participants, review characteristics, interventions, and outcomes in terms of WHA targets. The tool is appended in Appendix IX.

Synthesis

The report of results of the evidence summary synthesis from the selected SRs was prepared in the narrative form, which was extracted using a data extraction tool. The synthesis was

narratively structured based on the outcomes (i.e. the WHA targets); and evident interventions from the included SRs focussing on the WHA targets.

The effectiveness of nutrition specific and/or sensitive intervention was considered positive or mixed or no impact in terms of their role in improving indicators mentioned under WHA targets. The results from nutrition interventions have been stated positive (i.e. interventions showed reduction in the rates of stunting, wasting, low birthweight and anaemia or an increase exclusive breastfeeding rates); no impact (i.e. interventions showed no improvement in the rates of stunting, wasting, exclusive breastfeeding and low birthweight or a reduction in the prevalence of anaemia) and mixed impact (i.e. there are no conclusive evidence from the systematic reviews included). The evidence was harnessed based on the reviewers' conclusions in the SRs from LIMCs. We incorporated findings from the review of SRs in the report, though most of the interventions focused on nutrition-specific interventions, evaluating nutrition-related programmes and policies in LMICs. Only the findings from the LMICs were taken into consideration where both- LMICs and high-income countries (HICs) were included in SRs. Also, the evidence from SRs to understand factors responsible for success or failure of nutrition interventions in LMICs and in urban settings was used. A majority of such reviews showed no impact on the selected WHA outcomes in the present meta-review.

A compilation of the evidence was prepared in the light of quality of the SRs (as assessed by the AMSTAR tool), types of studies (i.e. meta-analysis or observational studies or narrative reviews), the effects and direction of the effects the reviews have reported in the selected SRs. When one SR addressed multiple interventions to assess the impact on a specific target, all such results were compiled from the specific SR. For example, for prevention of anaemia in reproductive age women, impact of a variety of nutrition specific interventions were included in the review and we had considered all such interventions and their respective impact on reduction of anaemia rates in women.

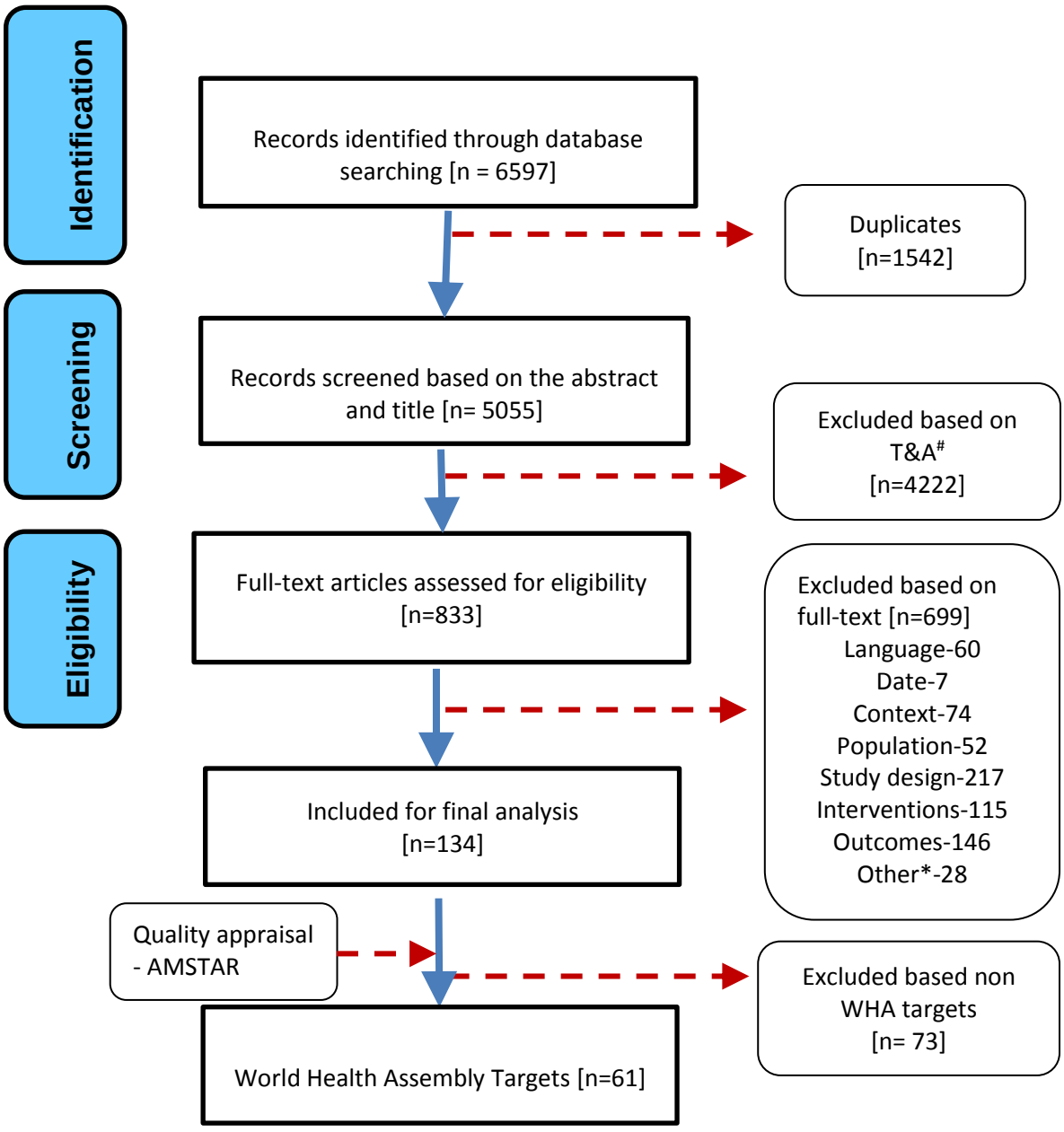
2.9 Quality assurance process

We used a systematic review management software, the EPPI-Reviewer, throughout the evidence summary process. To maintain quality assurance during the entire process we used these approaches- a standardised tool AMSTAR for methodological quality appraisal, the application of a priori inclusion and exclusion criteria, and double-blinded review process (three-staged screening, quality appraisal and data extraction) with reconciliation process conducted by a third investigator.

3 RESULTS

A total of 6597 records were identified through database searching. After the removal of duplicates and screening of title and abstracts, 833 reports were screened at full text. Re-application of the screening criteria and narrowing to include only those reviews reporting WHA outcomes lead to the final inclusion of 61 systematic reviews.

Figure 3.1 Flow of studies through the review



Title and abstract

* Withdrawn/old version/electronic version not available/no access to full text

A total of 61 SRs were identified, which examined the impact of 21 nutrition interventions on the following outcomes- stunting, anaemia, low birthweight, breastfeeding and wasting). They covered a range of populations (figure 1), and synthesised evidence from either randomised control trials (RCTs) only or randomised control trials and other type of studies (OTS) (i.e. RCTs + OTS) (figure 2). Regarding the income group, 30 SRs were from LMICs only and 31 from both-LMICs and HICs (High Income Countries) (figure 3). However, wherever SRs have considered both-LMICs and HICs, we have used only the impact for LMICs. Regarding the quality of included SRs (evaluated using AMSTAR tool), 34 (56%) were of high, 22 (36%) were of medium and only 5 (8%) were of low quality (figure 4).

In terms of interventions (figure 5), the largest group of SRs examined the impact of multiple micronutrients (17 SRs). The second largest was iron supplementation (9 SRs). Other interventions like-promotion of breastfeeding (5 SRs), zinc supplementation (5 SRs), folic acid supplementation (4 SRs), agricultural interventions (3 SRs), dietary diversity & complementary feeding (3 SRs), prevention & treatment of SAM (Severe Acute Malnutrition) and Vitamin D supplementation (2 SRs each) were also commonly examined. Conversely, interventions like-calcium supplementation, cash transfer, dietary interventions, integrated interventions, Kangaroo Mother Care (KMC), magnesium supplementation, LC-PUFA, school feeding program, supplementary feeding, Vitamin A supplementation, Vitamin C & E supplementation and WASH were examined in only 1 SR each.

Figure 1: Population groups in the included reviews

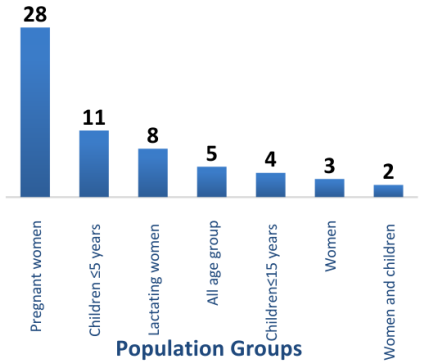


Figure 2: Study designs in the included reviews

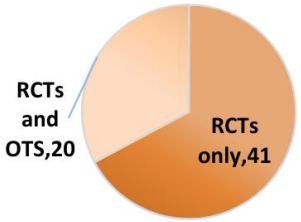


Figure 3: Income group in the included reviews

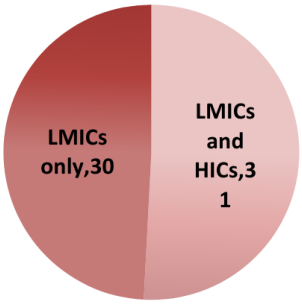


Figure 4: Study quality in the included reviews

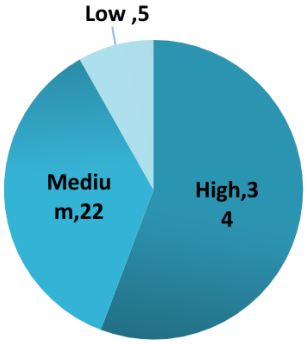
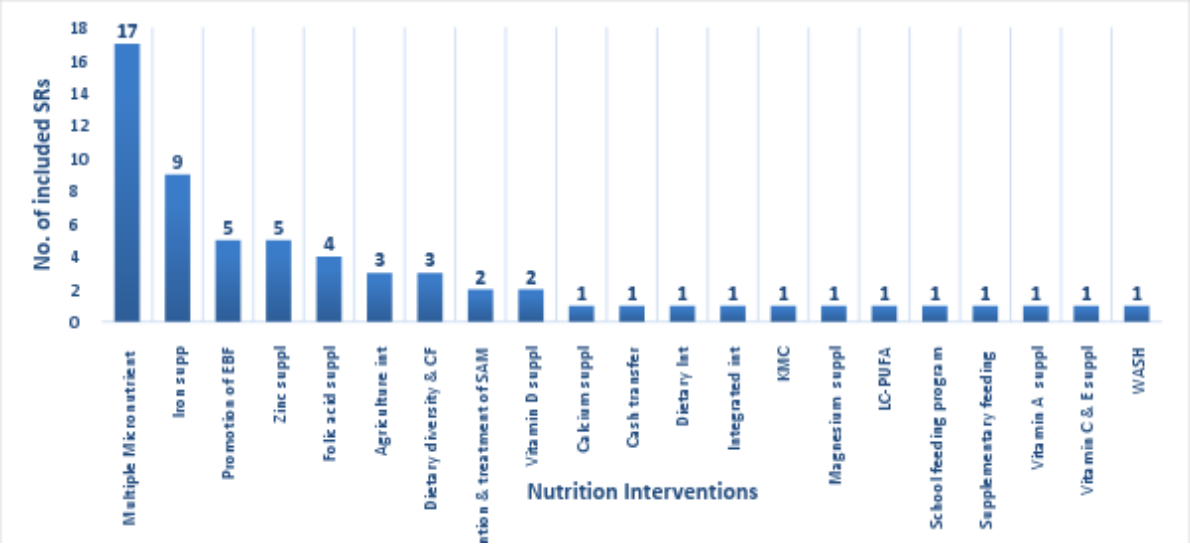


Figure 5: Nutrition interventions examined in the included reviews (Total 61 SRs)



Notes: CF-complementary feeding, EE-exclusive breastfeeding, Int-intervention, LC-PUFA-Long chain poly-unsaturated fatty acids, SAM-severe acute malnutrition, Suppl-supplementation, Wash-water sanitation and hygiene

TYPES OF NUTRITION INTERVENTIONS

Of the 21 nutrition interventions identified from 61 included SRs, more than half of them were found to have impact on more than one outcome.

Table 3: Overview of nutrition intervention in the included SRs

No	Interventions	Stunting	Anaemia	Low birth-weight	Breast-feeding	Wasting
1	Agriculture intervention	√				√
2	Calcium supplementation		√	√		
3	Cash transfer	√				
4	Dietary intervention			√		

5	Dietary diversity and CF	√				√
6	Folic acid supplementation		√	√		
7	Integrated intervention					√
8	Iron supplementation	√	√	√		√
9	Kangaroo Mother care				√	
10	LC-PUFA			√		
11	Magnesium			√		
12	Multiple Micronutrient	√	√	√		√
13	Prevention and treatment of SAM	√				√
14	Promotion of EF				√	
15	School feeding program	√				√
16	Supplementary feeding	√				√
17	Vitamin A supplementation		√	√		
18	Vitamin C and E supplementation			√		
19	Vitamin D supplementation			√		
20	WASH	√				√
21	Zinc supplementation	√		√		√

Notes: CF-complementary feeding, EE-exclusive breastfeeding, LC-PUFA-Long chain poly-unsaturated fatty acids, SAM-severe acute malnutrition, Wash-water sanitation and hygiene

A brief description of included nutrition interventions is presented below-

1. Agriculture interventions

Agricultural interventions were aimed at improving nutrition have been implemented by governments and development agencies since the 1960s (Masset et al., 2012). Examples of such interventions include home gardens, bio-fortification, poultry development, dairy development etc.

2. Calcium supplementation

Calcium, a key intracellular component for maintaining cell membranes has specific roles in nerve cell function, muscle contraction, enzyme and hormone actions, and is essential for bone mineralization (Pranom Buppasiri et al., 2015). Calcium status during pregnancy and lactation has a significant effect on fetal growth and development, thus, increase the requirements of calcium intake. Increased intakes of calcium not only to maintain maternal calcium balance and bone density, but also to meet the demands of the growing fetus/infant. These growing demands can be met through calcium supplementation, which can be given as oral daily dosage or as fortified product (calcium fortified juice).

3. Cash Transfer

Cash transfer programmes are a widely applied social protection scheme aiming at reducing poverty as well as breaking the cycle of poverty for the next generation through the development of human capital (Manley, Gitter and Slavchevska, 2012). Conditional cash transfer programmes provide money to households on the condition that they comply with certain pre-defined requirements. These conditions include, for example, up-to-date vaccinations, regular visits to a health care facility, regular school attendance by children, and

complying with health and nutrition promotion activities (e.g. attending education sessions, taking nutritional supplements, etc.).

4. Dietary interventions for mothers

Nutrition before conception and during pregnancy is important to ensure a healthy pregnancy outcome (Gresham et al., 2014). Poor maternal nutrition during pregnancy has been thought to lead to adverse birth outcomes and long-term negative consequences for the developing foetus. Maternal dietary interventions are known to have a positive impact on the developing foetus. These interventions may include dietary counselling and supplementation with food and fortified products.

5. Dietary diversity and complementary feeding

It is well recognized that the period of 6-24 months of age is one of the most critical time in the growth of an infant. Younger infants from 6 to 18 months are especially vulnerable to developing malnutrition (Lassi et al., 2013). In order to sustain the gains made by promoting exclusive breastfeeding for the first six months of life, interventions need to extend into the second half of infancy and beyond. Enabling caregivers to appropriately feed their children with safe and adequate complementary foods while maintaining frequent breastfeeding could ensure appropriate growth and development. Complementary feeding (CF) for infants refers to the timely introduction of safe and nutritional foods in addition to breast-feeding i.e. clean and nutritionally rich additional foods introduced at about six months of infant age. According to the World Health Organization, CF should be timely, adequate, appropriate, and given in sufficient quantity.

6. Folic acid supplementation

Foliate is an essential nutrient that is required for DNA replication and as a substrate for a range of enzymatic reactions involved in amino acid synthesis and vitamin metabolism. Demands for folate increase during pregnancy because it is also required for growth and development of the fetus (Greenberg et al., 2011) Folate deficiency has been associated with abnormalities in both mothers (anaemia, peripheral neuropathy) and foetuses (congenital abnormalities). Dietary supplementation with folic acid around the time of conception has long been known to have positive impact on the offspring. Folic acid can be supplemented alone or in combination with other micronutrients (iron, vitamin B_{12}, zinc).

7. Integrated interventions

Millions of children under 5 years of age in low and middle-income countries (LMIC) are failing to reach their potential in cognitive, language, and social emotional development, which has implications for their educational attainment and adult functioning (Grantham-Mcgregor et al., 2014). Poor levels of stimulation in the home, chronic undernutrition, and iron and iodine deficiencies are key risk factors; experts have called for large-scale programmes that integrate health, nutrition, and the promotion of child development. Integrated interventions may include-combination of early childhood development interventions (stimulation or pre-primary education) and nutritional interventions (breastfeeding, responsive feeding or multiple micronutrient supplementation).

8. Iron supplementation

Iron is an essential nutrient for all body tissues and is present in the brain of the developing foetus, where it is needed for proper formation of neural tissue and development of brain cells. Iron deficiency, a common form of nutritional deficiency, results from long-term imbalance caused by an inadequate dietary iron intake; poor iron absorption or utilisation; increased iron requirements for growth during childhood, adolescence or pregnancy; or chronic blood losses (De-Regil et al., 2014). In the later stages of iron depletion, the haemoglobin concentration decreases, resulting in a condition known as iron deficiency anaemia. Iron supplementation and/or fortification are known public health interventions to improve iron status and decrease anaemia. Iron supplementation may range from daily, intermittent (that is once, twice or three times a week on non-consecutive days) and weekly. Iron fortification may include-fortified wheat flour, fortified condiments and spices etc.

9. Kangaroo mother care

The World Health Organisation defines KMC with 4 components: early, continuous, and prolonged skin-to-skin contact (SSC) between the newborn and mother, exclusive breastfeeding, early discharge from the health facility, and close follow-up at home. This intervention aims at improving outcomes among preterm and low birthweight newborns (Boundy et al., 2016).

10. Long chain polyunsaturated fatty acids

Long-chain polyunsaturated fatty acids (LC-PUFA), particularly DHA and arachidonic acid (AA, 20:4n-6), are integral for foetal neural and retinal development, accrete extensively in these tissues in the last trimester of pregnancy, and are preferentially transported across the placenta to the developing foetus (Imhoff-Kunsch et al., 2012) The foetus has limited ability to synthesise DHA and, therefore, its supply is almost entirely dependent upon maternal transfer. Supplementing pregnant women with LC-PUFA can have an impact on both maternal and neonatal LC-PUFA status. Supplementation may include-fish oil (rich in LC-PUFA), DHA or DHA enriched food products given daily or weekly.

11. Magnesium

Magnesium is an essential mineral required for regulation of body temperature, nucleic acid and protein synthesis and in maintaining nerve and muscle cell electrical potentials. Many women, especially those from disadvantaged backgrounds, have low intakes of magnesium (Makrides and Crowther, 2001). Magnesium supplementation during pregnancy may be able to reduce foetal growth restriction and pre-eclampsia and increase birthweight. The supplementation is usually given as daily dosage.

12. Multiple micronutrients

Vitamins and minerals are essential for growth and metabolism. The World Health Organisation estimates that more than 2 billion people are deficient in key vitamins and minerals (WHO, WFA and UNICEF, 2007). Groups most vulnerable to these micronutrient deficiencies are pregnant and lactating women and young children, given their increased demands. Several strategies have been employed to supplement micronutrients to women and children. These include supplementation and food fortification. The WHO categorises food fortification strategies into three possible approaches: mass, targeted, and market driven (Das et al., 2013) Mass fortification involves foods that are widely consumed, such as wheat,

salt, sugar; targeted approaches fortify foods consumed by specific age groups like infant complementary foods; and the market-driven approach is when a food manufacturer fortifies a specific brand for a particular consumer niche. Food vehicles commonly used can be grouped into three broad categories: staples (wheat, rice, oils), condiments (salt, soy sauce, sugar), and processed commercial foods (noodles, infant complementary foods, dairy products). Multiple micronutrient supplementation may include minerals like-iron, folic acid, copper, iodine, zinc and/or vitamins like-B_1, B_2, B_6, B_{12}, A, D and E. Their dosage and durations of supplementation varies depending on age and physiological status.

13. Prevention and treatment of acute malnutrition (Moderate or Severe)

Moderate acute malnutrition, also called moderate wasting, affects around 10% of children under five years of age in low- and middle-income countries. There are different approaches to addressing malnutrition with prepared foods in these settings; for example, providing lipid-based nutrient supplements (which are foods with a high lipid content, usually ready-to-use) or blended foods (which are food mixtures – such as corn-soy blends, wheat-soy blends, sugar, oil, legumes, or others - that can be cooked at home by parents/caretakers to make a porridge or soup for children), either a full daily dose or in a low dose as a complement to the usual diet (Lazzerini, Rubert and Pani, 2013)

14. Promotion of Exclusive Breastfeeding (EBF)

Exclusive breastfeeding has been identified as one of the most important preventive interventions for child survival. In 2001, the World Health Organisation (WHO) recommended Exclusive breastfeeding for infants until 6 months of age. This recommendation has been incorporated into national health policies and child survival programs in many low and middle-income countries (LMICs). Nevertheless, low rates of Exclusive breastfeeding persist in LMICs and only 45% of infants are exclusively breastfed for 6 months (Victora et al., 2016) Interventions to EBF could be hospital based or community based, these may include- Baby Friendly Health Initiative (BFHI), capacity building of health workers to promote exclusive breastfeeding through counselling and peer support.

15. School feeding programme

School feeding programme as a social safety net has been popular in developing countries as an instrument for improving the nutritional status of children (Lawson, 2012). These programmes are frequently targeted towards populations that are food insecure and reside in areas with high concentrations of families from low socio-economic status, or towards schools that face poor attendance and enrolment of students. School feeding programme may include providing meal, snacks and beverages.

16. Supplementary feeding

Supplementary feeding involves provision of energy (with nutrients or micronutrients or both) through food (meals/snacks) or beverage to children to ameliorate or prevent undernutrition. This may be given in preschool, day care, or community settings; take-home or home-delivered rations are also included.

17. Vitamin A supplementation

Vitamin A is important for visual health, immune function and fetal growth and development. Vitamin A deficiency is a public health problem in many parts of the world, particularly Africa and South-East Asia (Haider et al., 2011). It can cause visual impairment in the form of night blindness and, in children, may increase the risk of illness and death from childhood infections, including measles and those causing diarrhoea. Although pregnant women are susceptible to vitamin A deficiency throughout gestation, susceptibility is at its highest during the third trimester of pregnancy due to accelerated fetal development and the physiological increase in blood volume during this period. Maternal vitamin A supplementation can reduce the severity of decline in maternal serum retinol levels during late pregnancy and the symptoms of night blindness. Supplementation may range from daily to weekly oral doses.

18. Vitamin C and E supplementation

Vitamin C and E act as antioxidants, Vitamin C scavenges free radicals in the aqueous phase, and the lipid-soluble vitamin E acts to prevent the formation of lipid peroxides and thus protect cell membranes (Rahimi et al., 2009). There is abundant evidence reporting considerable elevation of oxidative stress markers in pre-eclamptic women compared with normal pregnancy. In this condition, it seems that providing antioxidants such as Vitamin C and E through supplements is effective in preventing oxidative stress and subsequently prevent preeclampsia. Supplementation with Vitamin C and Vitamin E usually include oral daily doses.

19. Vitamin D supplementation

Vitamin D is an established fundamental nutritional factor responsible for regulation of bone metabolism, absorption of calcium and phosphate, and maintenance of muscle function (Pérez-López et al., 2015). Sufficient Vitamin D concentrations are needed during pregnancy to address the increasing demand for calcium, by the foetus, during its growth and development. To achieve sufficient concentrations, women are supplemented with vitamin D. It can be in different forms (D2 or D3), alone or in combination in multivitamins-calcium, iron.

20. WASH

In low-income countries an estimated 152 million children under the age of five years suffer from chronic undernutrition causing them to be short in height and 16 million children suffer from acute undernutrition causing them to be very thin (UNICEF-WHO-The World Bank Group, 2017). Poor growth in early life increases the risks of illness and death in childhood. The two immediate causes of childhood undernutrition are inadequate dietary intake and infectious diseases such as diarrhoea. Water, sanitation and hygiene (WASH) interventions are frequently implemented to reduce infectious diseases (Dangour et al., 2013) WASH interventions may include-1) improve the microbiological quality of drinking water or protect the microbiological quality of water prior to consumption; 2) introduce new or improved water supply or improve distribution; 3) introduce or expand the coverage and use of facilities designed to improve sanitation; or 4) promote hand washing with soap after defecation and disposal of child faeces, and prior to preparing and handling food, or a combination of these interventions, in children aged under 18 years.

21. Zinc supplementation

Zinc is known to play an important role in many biological functions, including protein synthesis and nucleic acid metabolism. It is a critical micronutrient for normal growth, immune function, and neurological development during infancy (Nissensohn et al., 2016) Low zinc concentrations during pregnancy may cause preterm birth or they may even prolong labour. Although severe zinc deficiency is now considered rare, mild to moderate deficiency may be relatively common throughout the world. Hence, preventive zinc supplementation may have several benefits; it can be given as daily or weekly dosage.

EVIDENCE SUMMARY PRESENTED BELOW FOR FIVE WHA TARGETS:

3.1. STUNTING

Of the total 61 included SRs, 21 (34%) reviews examined the impact of various nutrition interventions on reduction in the prevalence of stunting. Of the 21 included reviews, 16 reviews were synthesised using meta-analysis, while 5 were narrative reviews. Most of the included reviews addressed nutrition specific interventions (n=16), while five reviews belonged to nutrition sensitive interventions. The nutrition-specific interventions included: Multiple micronutrient fortification/supplementation (n=5), Iron supplementation (n=2), Zinc supplementation (n=2), Prevention and treatment of acute malnutrition (n=2), Supplementary feeding (n=2), Dietary diversity and complementary feeding (n=2), Mixed interventions (micronutrient, macronutrient, nutrition education and complementary feeding) (n=1). On the other hand, nutrition-sensitive interventions included: Agricultural interventions (n=2), WASH (n=1), Cash transfer (n=1), School feeding programme (n=1).

The evidence, which is presented in the subsequent sections on impact of stunting, was derived form 13 high quality, 7 medium and 1 low quality studies (Total 21 SRs).

Table 4: Overview of included reviews for stunting as an outcome

No	Authors	Intervention type	Intervention	Income Group	AMSTAR Rating
1	Das et al. [2013]	Nutrition-Specific	Multiple Micronutrient	Both	High
2	De-Regil et al. [2014]	Nutrition-Specific	Multiple Micronutrient	LMICs	High
3	Devakumar et al. [2016]	Nutrition-Specific	Multiple Micronutrient	LMICs	Medium
4	Wei-Ping et al. [2014]	Nutrition-Specific	Multiple Micronutrient	LMICs	Medium
5	Ramakrishnan et al. [2001]	Nutrition-Specific	Multiple Micronutrient	Both	Medium
6	De-Regil et al. [2011]	Nutrition-Specific	Iron supplementation	LMICs	High
7	Sachdev et al. [2005]	Nutrition-Specific	Iron supplementation	Both	High
8	Mayo-Wilson et al. [2014]	Nutrition-Specific	Zinc supplementation	Both	High

9	Nissensohn et al. [2016]	Nutrition-Specific	Zinc supplementation	Both	Medium
10	Lassi et al. [2013]	Nutrition-Specific	Dietary diversity and CF	LMICs	High
11	Dewey et al. [2008]	Nutrition-Specific	Dietary diversity and CF	LMICs	Medium
12	Lazzerini et al. [2013]	Nutrition-Specific	P & T of acute malnutrition	LMICs	High
13	Schoonees et al. [2014]	Nutrition-Specific	P & T of acute malnutrition	LMICs	High
14	Sguassero et al. [2012]	Nutrition-Specific	Supplementary feeding	LMICs	High
15	Kristjansson et al. [2015]	Nutrition-Specific	Supplementary feeding	LMICs	High
16	Dangour et al. [2013]	Nutrition-Sensitive	WASH	LMICs	High
17	Girard et al. [2012]	Nutrition-Sensitive	Agricultural intervention	LMICs	Medium
18	Masset et al. [2012]	Nutrition-Sensitive	Agricultural intervention	Both	High
19	McGregor [2014]	Nutrition-Specific	Combined intervention	LMICs	Medium
20	Manley et al. [2012]	Nutrition-Sensitive	Cash transfer	LMICs	High
21	Lawson [2012]	Nutrition-Sensitive	School feeding program	Both	Low

Note: CF-complementary feeding, P & T-prevention and treatment, WASH-water, sanitation and hygiene

The following sections were organised by intervention types for which the evidence of reduction in the stunting rates is made clear.

No	Intervention	Positive impact	No impact	Mixed impact of result
1	Multiple micronutrient fortification/supplementation		√	
2	Iron supplementation		√	
3	Zinc supplementation		√	
4	Dietary diversity and complementary feeding	√		
5	Prevention and treatment of acute malnutrition		√	
6	Supplementary feeding			√
7	WASH		√	
8	Agricultural intervention		√	
9	Combined intervention		√	
10	Cash transfer		√	
11	School feeding program			√

3.1.1) Effect of multiple micronutrient fortification/supplementation on stunting

Out of the 21 included SRs, five reviews examined the effect of multiple micronutrients on reduction in the prevalence of stunting rates (height/length for age z-score) in children.

Multiple Micronutrient Fortification						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Das et al. [2013]	Children >15 years of age	Multiple micronutrient fortification (specific)	34	RCTs + OTS	No impact
2	De-Regil et al. [2014]	Infants and young children 6 to 23 months	Home (point of use) fortification of food with MNP (specific)	2	RCTs	No impact

Out of these, two SRs examined effect of multiple micronutrient fortification using targeted approach (Das et al., 2013; De-Regil et al., 2014). They used various food vehicles for fortification, which included powders, staples, and condiments. The participants included were children <15 years of age and were provided with multiple fortified micronutrients for the duration of 3 months to 4 years.

The authors concluded that nutrition interventions in childhood using food-based approaches through fortification did not show any impact on the reduction of stunting (height/length for age z scores) rates in children.

Multiple Micronutrient Supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Devakumar et al. [2016]	Pregnant women	Multiple micronutrient Supplementation (specific)	6	RCTs	No impact
2	Wei-Ping et al. [2014]	Pregnant mothers	Multiple micronutrient Supplementation (specific)	4	RCTs	No impact
3	Ramakrishnan et al. [2001]	Children ≤5 years	Multiple micronutrient Supplementation (specific)	Vit A – 17 Iron – 27 Zinc – 43 MM – 20	RCTs	No impact

Note: OTS- other type of studies

The above three reviews assessed the effect of multiple micronutrient supplementations on stunting (Devakumar et al., 2016; Lu et al., 2014; Ramakrishnan, Nguyen and Martorell, 2009). The interventions varied across the studies. One SR supplemented UNIMMAP[1], developed by

1UNIMMAP - vitamin A 800 µg, thiamine 1.4 mg, riboflavin 1.4 mg, niacin 18 mg, vitamin B6 1.9 mg, folic acid 400 µg, vitamin B12 2.6 µg, vitamin C 70 mg, vitamin D 5 µg, vitamin E 10 mg, copper 2 mg, iodine 150 µg, iron 30 mg, selenium 65 µg, and zinc 15 mg

UNICEF, the United Nations University and WHO; while other two reviews included multiple micronutrient supplements of three or more micronutrients compared with supplementation with two or fewer micronutrients or placebo or no supplementation. The intervention was provided at different stages of lifecycle including pregnant women (Devakumar et al., 2016; Lu et al., 2014) and children (Ramakrishnan, Nguyen and Martorell, 2009). The studies had varied duration and dosage of multiple micronutrients supplementation.

The authors concluded that reviews did not show any significant impact of multiple micronutrient supplementations on the reduction of stunting prevalence in children.

Reviewers Conclusion

Overall, the evidence derived from LMICs on the effectiveness of multiple micronutrient interventions either through food fortification or supplementation showed no impact and thus, remains inconclusive. There were wide differences in the supplements included, dosage, duration of the use of supplements and type of micronutrients included in the supplements or food fortificants, which made the comparison difficult across the reviews.

Success and failure of the interventions

The included SRs used varied based on the food vehicles, duration of interventions, concentrations and types of micronutrients and the frequency of use or feeding/intake. Also, limited information was available on the confounding factors (age, nutritional status) at the initiation of the intervention, which limited inference on the impact on stunting. Thus these potential factors led to no impact of multiple micronutrient fortification on stunting outcome (Das et al., 2013).

3.1.2) Effect of iron supplementation on stunting

Of the total included SRs, only two reviews examined the effect of iron supplementation on improving the physical development in terms of height–or-age z-scores outcomes (De-Regil et al., 2011; Sachdev, Gera and Nestel, 2006). The target population included children <12 years of age. They were supplemented with iron supplements (elemental iron 25-75mg) on a weekly basis, however duration varied across the studies from 2-6 months.

The authors analyzed impact of iron supplementation in children and found no-significant effects on height-for-age z-scores.

Iron Supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	De-Regil et al. [2011]	Children under 12 years	Intermittent Iron supplementation vs daily supplementation or no supplementation or placebo (specific)	3	RCTs	No impact
2	Sachdev et al. [2006]	Infants, older children	Iron supplementation (specific)	23	RCTs	No impact

Reviewers' conclusion

Overall, evidence suggests that iron supplementation has no effect on liner growth of children. However, authors have reported a significant heterogeneity (inconclusive) with its greater impact on the weight-for-age (underweight) in supplemented children in malaria hyper-endemic regions and weight-for-height (wasting) for children above five years of age (Sachdev, Gera and Nestel, 2006). A negative effect on linear growth was observed in developed countries with iron supplementation for six months or longer.

Success and failure of the interventions

One of the reviews reflected on a few factors that could have led to the lack of impact of iron supplementation on stunting (De-Regil et al., 2011). The authors indicated an integrated approach with a strong behaviour change communication strategy to targets different audiences may be necessary to adequately support adherence and appropriate use for any supplementation regimen. The others associated with the iron supplementation interventions included: establishing the periodicity of the intervention over a year taking into account both its biological and programmatic feasibility; improving reporting of adherence and addressing the relevance of direct and continued supervision; and examining the cost effectiveness of intermittent compared with daily supplementation, taking into account more than just the differential cost of pills. Sachdev et al (2006) in their review indicated a few elements accountable for ineffective results of iron supplementation on stunting such as marginal food availability and poor feeding practices in developing countries; inability to translate the increased appetite and activity levels to increased energy intake and the need for further well-designed trails to evaluate multiple micronutrient supplementation to understand nutrient interactions in determining physical growth of children (Sachdev, Gera and Nestel, 2006).

3.1.3) Effect of zinc supplementation on stunting

Two reviews examined the impact of zinc supplementation on the physical growth (length/height for age z scores) of the children (Mayo-Wilson et al., 2014; Nissensohn et al., 2016). Target population was children aged ≤ 12 years. The supplementation ranged from daily or weekly basis, with duration <12 months and dosage ≤ 20 mg/day.

The authors observed no impact of zinc supplementation on the prevalence of stunting and found evidence to be inconclusive.

Zinc Supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Mayo-Wilson et al. [2014]	Over 5 years of age	Zinc supplementation and additional iron (specific)	6	RCTs	No impact
2	Nissensohn et al. [2016]	Infants > 12 months	Zinc supplementation (specific)	10	RCTs	No impact

Reviewers' Conclusion

Overall, zinc supplementation was not found to be effective in improving linear growth or stunting prevalence.

Success and failure of the interventions

The reviews found a few challenges in delivering the interventions such as: dosage modulation and formulation and frequency of use of the formulations for positive outcome on stunting. Also, uptake and cost of zinc administration (separate/combined) effects was not considered.

3.1.4) Effect of dietary diversity and complementary feeding on stunting

Of the total included 21 reviews, two reviews assessed the impact of education and provision of complementary feeding on the growth (height/length for age z scores) outcomes (Lassi et al., 2013; Dewey and Adu-afarwuah, 2008). The interventions included the following categories: education regarding complementary feeding (as their main treatment); complementary food or a food product offering extra energy (with or without added micronutrients) provided as the only treatment; provision of food combined with some other strategy, usually education for mothers; fortification of complementary foods (centrally processed fortified foods or home fortification products) with micronutrients (with no difference in energy provided to intervention versus control groups) and increased energy density and/or nutrient bioavailability of complementary foods through the use of simple technologies. The target population for intervention was < 2 years children.

Dietary diversity and complementary feeding						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lassi et al. [2013]	Children > 2 years	Dietary diversity & complementary feeding practices (specific)	5	RCTs + OTS	Positive
2	Dewey et al. [2008]	Lactating Mother	Dietary diversity & complementary feeding practices (specific)	8	RCTs + OTS	Positive

Authors stated, education of complementary feeding alone and with complementary feeding had positive impact on the linear growth (length/height for age z scores) in food insecure populations (i.e. population with an average per capita income under USD 1.25) and significantly reduced the rates of stunting.

Reviewers Conclusion

Overall, the evidence suggests that dietary diversity and complementary feeding practices have a positive impact on the linear growth of children less than two years of age, especially in food insecure populations.

Success and failure of the interventions

The authors suggested that along with complementary feeding interventions, especially among food insecure populations, education in conjunction with affordable and effective complementary food would be potentially have impact on stunting. Also, there is no single universal 'best' package available for the complementary feeding, which indicates the need

for a holistic approach towards the success of the intervention for the outcome (stunting). While developing the package the initial nutritional status, availability of nutrient rich foods locally to develop complementary food and micronutrient fortification need to be considered.

3.1.5) Effect of combined nutrition and child development interventions on stunting

The narrative review used integrated strategy in nutrition interventions and child development, and explored their impact on stunting outcomes (Grantham-Mcgregor et al., 2014). The interventions used were target specific (<5 years and pregnant women). Nutrition interventions included; nutrition specific-micronutrient and micronutrient supplementation, nutrition education, breast feeding promotion or responsive feeding; stimulation specific-centre based preschool and day care, parent groups, individual parent counselling or home visiting and child development specific- child cognition, language, motor, socio-emotional development, behaviour, school retention, school achievement.

The authors did not find any significant effect of nutrition interventions on the linear growth of children when combined with child development interventions. This could be attributed to the varying duration of studies included, age of the children (smaller the age the lesser the benefits) and the initial nutritional status of children at the beginning of the study.

Combined nutrition intervention and child development						
No	**Author**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	McGregor [2014]	Women (PW), infants and children >5	Micronutrient, macronutrient, nutrition education, complementary feeding (specific)	RCTs + OTS – 13 Program evaluation - 8	RCTs + OTS	No impact

Success and failure of the interventions

The authors suggested that more rigorous interventions with holistic approach needs to be evaluated at the community level for longer durations as the impact of such interventions need enough time to show a change in stunting prevalence. The authors suggested a need for well-designed efficacy trials in the future.

3.1.6) Effect of prevention and treatment of acute malnutrition on stunting

Of the total included reviews, two meta-analytic reviews examined the effect of specially formulated foods and ready to use therapeutic foods (RUTF) for home-based treatments (Lazzerini, Rubert and Pani, 2013; Schoonees et al., 2013). The intervention for the experimental group was provided in the form of lipid based supplements (containing high energy density foods) and blended food supplements (containing corn soy blended foods or other blended foods such as wheat soy flour, sugar, oil, legumes or others), while control group was provided alternative RUTF type (corn/soy based versus peanut based, reduced milk powder) and treatment as usual dieat (standard home diet). The intervention was provided to children from six months to five years of age.

The authors did not find any difference in the reduction of stunting rates in comparison to the control group.

Prevention and treatment of SAM						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lazzerini et al. [2013]	Children 6-60 Months of Age	Specially formulated foods for SAM (specific)	3	RCTs + OTS	No impact
2	Schoonees et al. [2014]	Children between six months and five years of age with SAM	Home Based RUTF (specific)	1*	RCTs	No impact

*Only one study included in the SR examined the impact on children between six months and five years of age with SAM.

Reviewers Conclusion

Overall, evidence suggests that prevention and treatment of SAM using specifically formulated foods or home based RUTF had no impact on stunting.

Success and failure of the interventions

The authors found inadequate knowledge of utilizing local foods habits for rehabilitation. Also, for the effectiveness of such interventions, each treatment programme of MAM should incorporate package of preventive strategies ensuring long-term effects rather than just focusing on provision of food supplements, which is short-term solution.

3.1.7) Effect of supplementary feeding on stunting

The two reviews examined the impact of supplementary feeding for the improvement in linear growth outcomes (Sguassero et al., 2012; Kristjansson et al., 2015). The interventions varied across the studies. Sguassero et al. (2012) provided supplementary feeding, i.e. the provision of extra food to children or families beyond the normal rations of their home diets, which comprised of meals (local and imported foods), drinks (juices and milk), and snacks (including both food and milk snacks), on the contrary control groups were provided with either no treatment (home diet or no extra feeding) or placebo (for example low or no protein and low energy drinks). Other review by Kristjansson et al. (2015) provided energy and macronutrients through hot or cold meals (breakfast or lunch), snacks (including both food and beverages such as milk or milk substitutes), meals or snacks in combination with take home rations, take home rations. These interventions were provided for ≤ 5 years children for the duration of < 12 months.

Sguassero et al. (2012) assessed supplementary feeding provided via community-based approach for the promotion of linear growth outcomes and found to have no evidence of difference in the outcomes. On the contrary, the review by Kristjansson et al. (2015) assessed supplementary feeding's effectiveness alone or in combination with co-interventions for improving the physical growth of disadvantaged children. Further, results from sub-group analysis (study type-RCTs vs before and after) reported significant evidence of

supplementation with randomized control studies compared to non-significant effect from controlled pre and post studies.

Supplementary feeding						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Sguassero et al. [2012]	Children > 5 years of age	Supplementary Feeding [Multiple mixture] (specific)	2	RCTs	No impact
2	Kristjansson et al. [2015]	Children 3 - 5 years	Food Supplementation [RUTF, Sweetened condensed milk, bread, cereal, flours, vegetable mixture, fruit, lentils, rice] (specific)	9	RCTs + OTS	Positive

Reviewers Conclusion

Overall, the evidence suggests mixed effect of supplementary feeding on linear growth. Hence, we cannot suggest any firm conclusion.

Success and failure of the interventions

The author Kristjansson et al. (2015), showed positive impact of supplementary feeding on stunting, and the factors leading to such impact could be- feeding given in day care could be more effective than that given at home, supervised feeding may produce better child outcomes; whereas they also indicated potential failure factors such as breakdown in supply chain leading to failure in delivery of feeding to family and disruption of breastfeeding.

3.1.8) Effect of WASH intervention for stunting

One review by evaluated the effect of WASH practices (Dangour et al., 2013). Interventions aimed at improving the microbiological quality of drinking water, introducing a new or improved water supply or improved distribution, expanding the coverage and use of facilities designed to improve sanitation and promotion of hand washing with soap after defecation, disposal of faeces and prior to preparing and handling foods (group discussions, media, campaigns, leaflets, songs, pictorial stories, dramas etc.). Participants were children under <18 years.

The authors reported no effect on height/length-for-age z-score. Similarly, the subgroup analysis suggested no evidence of an effect on height/length-for-age z-score for boys; however, girls demonstrated some evidence of impact on the height-for-age Z score.

WASH						
No	**Author**	**Population**	**Intervention(type)**	**Included studies**	**Study Design**	**Impact**
1	Dangour et al. [2013]	Intervention: Children under 5 years, Outcome: Children under 18 years	WASH (sensitive)	9	RCTs + OTS	No impact

Success and failure of the interventions

The review by Dangour et al. (2013) specified lack of evidence on intervention adherence, attrition and costs, long-term studies on WASH interventions and its impact on childhood nutrition outcomes.

3.1.9) Effect of agricultural interventions on stunting

Of the included reviews, two reviews systematically examined the effect of agricultural interventions increasing the household food production on the nutrition and linear growth outcomes (Girard et al., 2012; Masset et al., 2012). Agricultural interventions included bio fortification, home gardens, small-scale fisheries and aquaculture, dairy development and farming of cash crops. Population targeted by the interventions included, people form poor geographical areas, women, poor households or remote communities.

The author concluded that agricultural intervention strategies had no impact on the prevalence of stunting.

Agricultural interventions						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Girard et al. [2012]	Intervention: Women and Children Outcome: Children	Agricultural Interventions to improve household food production (sensitive)	4	RCTs + OTS	No impact
2	Masset et al. [2012]	Intervention: All age group, Outcome: Children	Agricultural interventions (sensitive)	8	RCTs	No impact

Reviewers Conclusion

Overall evidence suggests agricultural interventions were not effective in improving linear growth. Probably, a combination of nutrition-specific with agricultural interventions may have potential impact on stunting.

Success and failure of the interventions

Although, the reviews, showed inconclusive impact of agriculture intervention on stunting outcome, the authors reflected elements of a few programmes wherein benefit pattern emerged considering- production of foods that were rich sources of not only micronutrients but energy and/or protein as well, crop production strategies that promoted orange-flesh sweet potato (OFSP) and legumes or included animal production strategies (Girard et al., 2012).

3.1.10) Effect of cash transfer intervention on stunting

One meta-analytic review by assessed the effectiveness of cash transfer programmes (conditional and non-conditional) on the child linear growth outcomes (Manley, Gitter and

Slavchevska, 2012). The interventions included various cash transfer programmes in the following countries- Bangladesh (Food Security Vulnerable Group Development, Food for Asset Creation, Rural Maintenance Program, Primary Education Stipend), India (Apni Beti Apna Dhan), Malawi (Malawi Social Cash Transfer) and SriLanka (Smrudhi) etc. The aim of these interventions varied across different programs (encouraging use of healthcare, increasing food diversity, increasing household food consumption expenditure, maternal participation in educational talks, provision of food supplements, payment size etc.) with common outcome of improved nutrition status (height/length for age z-scores).

The authors did not find any evidence of cash transfer programs on stunting outcome.

Cash transfer						
No	**Author**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Manley et al. [2012]	Intervention: All age group Outcome: Children	Cash Transfer (sensitive)	18	RCTs + OTS	No impact

Success and failure of the interventions

The above review synthesised programmes (social assistance programmes in form of cash transfer) which show positive impact on nutritional status of children in countries with poor infant mortality rates and low number of hospital beds per capita. The authors identified other important factors that might have caused poor impact of such programme such as lack of incorporation of impact evaluation into social assistance programmes/interventions; lack of causes that lead to programme implementation and sustainability; politics of programme adoption and continuation and lack of evidence on circumstances, which contribute to high marginal returns on investment. Multiple factors have been attributed to the lack of impact on stunting.

3.1.11) Effect of school feeding program on stunting

One narrative review by examined the impact of school feeding programmes on educational and agricultural developmental goals with the aim of presenting a conceptual framework of how food for education programs work and their impact on children height for age outcome and families linking it with agricultural development Lawson (2012). Educational programmes included school feeding programmes and take home rations while agricultural developmental goals included social safety nets. The intervention was given using various food vehicles such as meals, snacks and beverage. The interventions had targeted children to assess their anthropometric measurements for the duration of 4 - 24 months.

The author had mixed results for the impact on stunting considering school feeding programme as an intervention. It did not show significant results when intervention involved snacks or beverages. However, take home ration programme showed a positive relation on the effect of stunting.

School Feeding Program						
No	**Author**	**Population**	**Intervention**	**Included studies**	**Study Design**	**Impact**
1	Lawson [2012]	School children	School feeding program (sensitive)	6	RCTs + OTS	Mixed

Success and failure of the interventions

The author of the review Lawson (2012) indicated few factors contributing to inconclusive impact of school feeding program on the nutritional status of children: measures of cost effectiveness, issues related to sustainability and impact on local agricultural development, issues of implementation of the programme in terms of logistic challenges, interruptions in food delivery, and food being given to untargeted children or students.

3.2 Anaemia

Of the total 61 included reviews, 16 (26%) reviews examined the impact of various nutrition interventions on reducing anaemia among women of reproductive age. Of the 16 included reviews, 14 were synthesized using meta-analysis, while 2 were narrative reviews. All the included reviews belonged to nutrition specific intervention. The interventions included: Multiple-micronutrient supplementation/fortification (n=7), Iron supplementation/ fortification (n=6), Folic acid supplementation (n=1), Vitamin A and Carotenoids (n=1), Calcium Supplementation (n=1).

The evidence presented in the subsequent sections on impact in reducing anaemia among women of reproductive age is derived from 11 high quality and 5 medium quality studies (Total 16 SRs).

No	Authors	Nature of intervention	Intervention	Income Group	AMSTAR Rating
1	Abe et al. [2016]	Nutrition Specific	Multiple-micronutrient supplementation	Both	High
2	Bhutta et al. [2012]	Nutrition Specific	Multiple-micronutrient supplementation	LMICs	Medium
3	Haider et al. [2011]	Nutrition Specific	Multiple-micronutrient supplementation	LMICs	Medium
4	Haider et al. [2015]	Nutrition Specific	Multiple-micronutrient supplementation	Both	High
5	Hess et al. [2016]	Nutrition Specific	Micronutrient fortification	LMICs	High
6	Das et al. [2013]	Nutrition Specific	Micronutrient fortification	Both	High
7	Suchdev et al. [2015]	Nutrition Specific	Micronutrient fortification	LMICs	High
8	Low MSY et al. [2016]	Nutrition Specific	Iron supplementation	LMICs	High
9	Pena-Rosas et al. [2007]	Nutrition Specific	Iron supplementation	Both	High

10	Peña-Rosas et al. [2015]	Nutrition Specific	Iron supplementation	Both	High
11	Peña-Rosas et al. [2012]	Nutrition Specific	Iron supplementation	LMICs	High
12	Pacho´n et al. [2015]	Nutrition Specific	Iron fortification	LMICs	Medium
13	Yakoob et al. [2011]	Nutrition Specific	Iron supplementation	Both	Medium
14	Lassi ZS et al. [2013]	Nutrition Specific	Folic Acid Supplementation	Both	High
15	Lyman et al. [2012]	Nutrition Specific	Vitamin A and Carotenoids	LMICs	Medium
16	Buppasiri et al. [2015]	Nutrition Specific	Calcium Supplementation	Both	High

The following sections are gave an overview of the results on the basis of types of intervention for reduction in anaemia.

No.	Interventions	Positive impact	No impact
1	Multiple micronutrient fortification/ supplementation		√
2	Iron supplementation	√	
3	Folic acid supplementation		√
4	Vitamin A and Carotenoids supplementation	√	
5	Calcium supplementation		√

3.2.1) Effect of multiple micronutrient supplementation/fortification on maternal anaemia

Of the 16 included SRs, seven reviews examined the effect of multiple micronutrients on reduction in anaemia among women of reproductive age.

Of these, four reviews examined the effect of multiple micronutrient supplementation (Abe et al., 2016; Bhutta et al., 2012; Haider, Yakoob and Bhutta, 2011; Ba and Za, 2016). Of which, one narrative review (Abe et al., 2016) used multiple micronutrient supplementation versus placebo, no supplementation or supplementation with two or fewer micronutrients on lactating mother (Abe et al., 2016) while other three reviews used multiple micronutrient supplementation versus IFA supplementation on pregnant women (Bhutta et al., 2012; Haider, Yakoob and Bhutta, 2011; Ba and Za, 2016). All the reviews used UNIMMAP supplementation which consisted of 30mg iron, 400µg folic acid, 15 mg zinc, 2mg copper, 65 µg selenium, 800µg RE vitamin A, 1.4mg vitamin B1, 1.4mg vitamin B2, 18mg niacin, 1.9mg vitamin B6, 2.6µg vitamin B12, 70mg vitamin C, 5 µg vitamin D, 10mg vitamin E and 150µg iodine though duration of the intervention varied across the reviews (Haider, Yakoob and Bhutta, 2011).

Multiple Micronutrient Supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Abe et al. [2016]	Lactating mother	Multiple-micronutrient supplementation (specific)	1*	RCTs	No Impact

2	Bhutta et al. [2012]	Pregnant women	Multiple-micronutrient supplementation (specific)	7	RCTs	No Impact
3	Haider et al. [2011]	Pregnant women	Multiple-micronutrient supplementation (specific)	4	RCTs	No Impact
4	Haider et al. [2015]	Pregnant women	Multiple-micronutrient supplementation (specific)	5	RCTs	No Impact

The authors concluded that evidence did not show any impact on the reduction of anaemia in pregnant and lactating women.

Multiple Micronutrient Fortification						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Hess et al. [2016]	Children <50 years	Micronutrient fortified condiments and noodles (specific)	11	RCTs	Positive
2	Das et al. [2013]	All age group	Food fortification with single, dual or multiple micronutrient (specific)	20	RCTs + OTS	Positive
3	Suchdev et al. [2015]	Pregnant women	Multiple micronutrient powders for fortification (specific)	1*	RCTs	No Impact

*Only one study in the SR examined the intervention impact on the specific population group

Remaining three assessed the effect of multiple micronutrient fortification reviews (Hess, Tecklenburg and Eichler, 2016; Das et al., 2013; Suchdev et al., 2015). Of these two reviews (Hess, Tecklenburg and Eichler, 2016; Das et al., 2013) used multiple micronutrient fortification in condiments, noodles (Hess, Tecklenburg and Eichler, 2016), while in other review staples, condiments and processed food vehicles were fortified with varying micronutrients (Das et al., 2013). The review conducted by Suchdev et al., (2015) used multiple micronutrient powders for home (point-of-use) fortification of foods. The participants included in these three reviews were children and adults from 5 to 50 years (Hess, Tecklenburg and Eichler, 2016), women of reproductive age, pregnant women, post-menopausal women (Das et al., 2013) and pregnant women (Suchdev et al., 2015). The duration of the interventions ranged from 2 months to 2 years (Hess, Tecklenburg and Eichler, 2016; Das et al., 2013) and no limit in one of the review (Suchdev et al., 2015).

The two authors concluded that MMN fortification significantly reduced anaemia prevalence (Hess, Tecklenburg and Eichler, 2016; Das et al., 2013)*. Whereas other review* (Suchdev et al., 2015) *concluded that multiple micronutrient fortification showed no impact on the reduction of anaemia in pregnant and lactating women.*

Reviewers Conclusion

Overall the evidence suggests that multiple micronutrient supplementations did not show any conclusive impact on reducing anaemia prevalence. However, multiple micronutrient fortification interventions appears to be promising, however, remains inconclusive

Success and failure of the interventions

Failure factors mentioned by the reviewers indicated that small number of studies, sample sizes and non-applicability of outcomes could be responsible for inconclusive impact of multiple micronutrient supplementation in reducing maternal anaemia (Abe et al., 2016). Also, timing of initiation of multiple micronutrient supplements, dosage and infections might have added to the inconclusive impact (Haider et al., 2011). The methodological limitations of the studies included and lack of studies could be responsible for inconclusive impact (Suchdev et al., 2015).

3.2.2) Effect of iron supplementation on maternal anaemia

Of the 16 included SRs, six reviews examined the effect of multiple micronutrients on reduction in anaemia among women of reproductive age.

The RCTs used oral iron supplementation versus placebo or intermittent supplement regimens (Low et al., 2016; Pena-Rosas and Viteri, 2006; Pena-Rosas et al., 2015; Yakoob and Bhutta, 2011). The dosage of intervention varied in these four reviews wherein one of the review used elemental iron from 1mg to 300mg for 1-24 weeks (Low et al., 2016), while in other review it varied in terms of daily routine oral supplementation with iron or folic acid compared to no supplementation/placebo or routine intermittent (weekly and twice weekly) regimens and intermittent oral iron or iron-folic acid supplementation compared to no supplementation/placebo (Pena-Rosas and Viteri, 2006). The dosage of intervention in another review ranged between 9mg to 900 mg of elemental iron (daily) and in some groups folic acid daily dose ranged from 10 µg (0.01 mg) folic acid to 5000 µg (5 mg) along with the iron (Peña-Rosas et al., 2015). Daily iron supplementation compared with no supplementation was intervened in review conducted by (Yakoob and Bhutta, 2011). The participants studied in the reviews were pregnant women (Pena-Rosas and Viteri, 2006, Peña-Rosas et al., 2015, Yakoob and Bhutta, 2011) and menstruating women (Low et al., 2016). Two reviews considered urban context while examining the effect of intervention in reducing prevalence of anaemia (Low et al., 2016; Peña-Rosas et al., 2015).

The review conducted by Low et al. (2016) concluded that women receiving routine oral iron supplementation were less likely to be anaemic in comparison to the women who had been receiving placebo or intermittent supplements. There was variation among trials in terms of the size of the treatment effect. Similarly, another review concluded that women who receive routine daily supplementation with iron during pregnancy are less likely to have anaemia at term than those taking placebo or not taking any iron supplements at all (Pena-Rosas and Viteri, 2006). In the same manner, Peña-Rosas et al. (2015) also concluded that those who received daily iron supplements during pregnancy are less likely to be anaemia at term (13.06%) compared to who did not receive iron or placebo (35.71%). Lastly, authors of the review also concluded that there was a statistically significant 73% reduction in the incidence of anaemia at term (Yakoob and Bhutta, 2011). The pooled analysis of effect of daily iron supplementation vs. control had a high heterogeneity, hence, should be interpreted with caution.

Iron supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Low MSY et al. [2016]	WRA	Iron supplementation (specific)	10	RCT	Positive
2	Pena-Rosas et al. [2006]	Pregnant women	Iron supplementation (specific)	13	RCTs	Positive
3	Peña-Rosas et al. [2015]	Pregnant women	Iron supplementation (specific)	14	RCTs	Positive
4	Peña-Rosas et al. [2012]	Pregnant women	Iron supplementation (specific)	4	RCTs	No Impact
5	Yakoob et al. [2011]	Pregnant women	Iron supplementation with or without folic acid (specific)	18	RCTs	Positive

The review conducted by Pena-Rosas et al., (2012) examined oral supplements of iron or iron + folic acid or iron + vitamins and minerals given as a public health strategy on an intermittent basis and compared with a placebo or no supplementation or compared with the same supplements provided daily. The weekly dose of iron ranged between 80 mg elemental iron and 200 mg of iron. Folic acid intermittently as part of the intervention, the doses were: 400 µg (0.4 mg) folic acid per week, 500 µg (0.5 mg) folic acid, 1000 µg (1 mg) folic acid per week , 1500 µg (1.5 mg) folic acid a week , 2000 µg (2.0 mg) folic acid per week , 3500 µg (3.5 mg) folic acid. The participants included in the review were pregnant mothers.

The review included four trials and the authors concluded that there was no significant impact on the prevalence anaemia between the supplemented and control/placebo groups.

The narrative review conducted by Pachón et al., (2015) had assessed the effectiveness of flour fortification programs by iron- wheat flour (alone or in combination with maize flour) fortified with iron. The participants consisted of a general population of 2 years and older including pregnant mothers from thirteen countries.

Iron fortification						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1.	Pacho´n et al. [2015]	General population >2 years	Wheat flour (alone or in combination with maize flour) fortified with iron (specific)	13	RCTs + OTS	Positive

The authors concluded that iron fortification of wheat flour alone or in combination with maize flour showed a significant reduction in the prevalence of anaemia.

Reviewers Conclusion

Overall the evidence suggests a positive impact of iron supplementation with or without folic acid, and fortification in reducing prevalence of anaemia in pregnant women and women of reproductive age.

3.2.3) Effect of folic acid supplementation on maternal anaemia

A RCT conducted by Lassi, Salam, et al., (2013) assessed the effectiveness of oral folic acid supplementation alone with other micronutrients versus no folic acid (placebo or same micro nutrients but no folic acid). The dosage of folic acid ranged from 10 µg to 350 mg (along with multiple micronutrient). The participants were pregnant mother and duration of the intervention was during pregnancy from the 8th week of pregnancy till three days postpartum. The author had conducted haematological and biochemical parameters during pregnancy and on its neonatal outcomes.

The authors stated that folic acid supplementation did not show any impact on reducing pre-delivery anaemia. The authors included all studies reporting anaemia but pooled them separately according to the definition of anaemia used. Due to fewer numbers of studies, authors could not find any conclusive evidence of the benefit of folic acid supplementation during pregnancy on pregnancy outcomes.

Folic Acid supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lassi ZS et al. [2013]	Pregnant women	Folic Acid Supplementation	8	RCTS+ OTS	No Impact

3.2.4) Effect of vitamin A and carotenoids supplementation on maternal anaemia

The review conducted by Lyman, (2012) evaluated the impact of Vitamin A and Carotenoids supplementation in reducing the prevalence of maternal anaemia. They identified the trials which had isolated the effects of vitamin A or beta-carotene supplementation during pregnancy from a weekly dose providing the equivalent dose of 3333 IU of vitamin A to 10,000 IU per day.

The authors concluded that overall evidence indicated significant impact irrespective of any form of vitamin A or beta carotene. It reduced the risk of maternal anaemia (Hb < 11g/dL) by 19% during pregnancy follow up. However, vitamin A supplementation did not have any impact on severe anaemia during pregnancy.

Vitamin A and Carotenoids Supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lyman et al. [2012]	Pregnant women	Vitamin A and Carotenoids	6	RCTs	Positive

3.2.5) Effect of calcium supplementation on maternal anaemia

A review conducted by Buppasiri et al., (2015) examined the effect of calcium supplementation with a dosage of 1000 mg/d or more (range 1000 to 2000 mg/d; less than 1000 mg/day (range 300 mg to 600 mg); calcium supplementation (Caltrate) was prescribed 600 mg at 22 to 32 weeks' gestational age and then 1200 mg from 32 weeks until delivery. The participants included in the review were pregnant women. The duration of the calcium supplementation varied across the trials included in the review.

The authors concluded that evidence shows no impact of calcium supplementation on maternal anaemia in pregnancy probably due to the inhibitory effect of calcium on iron absorption.

Calcium supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Buppasiri et al. [2015]	Pregnant women	Calcium Supplementation	1	RCTs	No Impact

Overall conclusion

The review of evidence from SRs on interventions that addressed anaemia among the reproductive age women including pregnant women showed that iron supplementation and vitamin A/ carotenoid supplementation reduced the prevalence of anaemia. The evidence may have promising results considering the fact that women of reproductive age, especially in the low resource settings, have deficiencies of iron and vitamin A (as the majority are vegetarians by choice) and supplementation of these two nutrients may prove to be beneficial in reducing the prevalence of anaemia.

3.3 Low Birth Weight

Of the total 61 included reviews, 24 (39%) reviews examined the impact of various nutrition interventions in reducing the rates of low birthweight. Of the 24 included reviews, 22 were synthesized using meta-analysis, while 2 were narrative reviews. All the included reviews were focused on nutrition-specific interventions. The interventions included: Multiple-micronutrient supplementation (n=6), Iron supplementation (n=3), Zinc supplementation (n=2), Folic acid supplementation (n=4), Vitamin D (n=3), Vitamin A and Carotenoids (n=1), Calcium supplementation (n=1), Vitamin C and E (n=1), Dietary interventions (n=1), n-3 LCPUFA supplementation (n=1), Magnesium supplementation (n=1).

The impact of reduction in the rates of low birthweight was derived from 14 high quality, 7 medium and 3 low quality SRs (n = 24 SRs).

No	Authors	Intervention type	Intervention	Income Group	AMSTAR Rating
1	Shah et al. [2009]	Nutrition Specific	Multiple micronutrient	Both	High
2	Shrimpton et al. [2009]	Nutrition Specific	Multiple micronutrient	LMICs	Low
3	Zerfu et al. [2013]	Nutrition Specific	Multiple micronutrient	Both	Low
4	Fall et al. [2009]	Nutrition Specific	Multiple micronutrient	LMICs	Low
5	Haider et al. [2015]	Nutrition Specific	Multiple micronutrient	Both	High
6	Kawai et al. [2011]	Nutrition Specific	Multiple micronutrient	LMICs	Medium
7	Pena-Rosas JP et al. [2007]	Nutrition Specific	Iron supplementation	Both	High

8	Peña-Rosas et al. [2015]	Nutrition Specific	Iron supplementation	Both	High
9	Peña-Rosas et al. [2012]	Nutrition Specific	Iron supplementation	LMICs	High
10	Chaffee et al. [2012]	Nutrition Specific	Zinc supplementation	Both	High
11	Ota E et al. [2015]	Nutrition Specific	Zinc supplementation	Both	High
12	Saccone et al. [2016]	Nutrition Specific	Folic acid supplementation	Both	Medium
13	Lassi ZS et al. [2013]	Nutrition Specific	Folic acid supplementation	Both	High
14	De-Regil et al. [2010]	Nutrition Specific	Folic acid supplementation	Both	High
15	De-Regil et al. [2015]	Nutrition Specific	Folic acid supplementation	Both	High
16	López et al. [2015]	Nutrition Specific	Vitamin D supplementation	Both	Medium
17	De-Regil LM et al. [2016]	Nutrition Specific	Vitamin D supplementation	Both	High
18	Lyman et al. [2012]	Nutrition Specific	Vitamin D supplementation	Both	Medium
19	Lyman et al. [2012]	Nutrition Specific	Vitamin A	LMICs	Medium
20	Buppasiri et al. [2015]	Nutrition Specific	Calcium supplementation	Both	High
21	Rahim et al. [2009]	Nutrition Specific	Vitamin C and E Supplementation	Both	Medium
22	Gresham et al. [2014]	Nutrition Specific	Dietary interventions	Both	Medium
23	Kunsch et al. [2012]	Nutrition Specific	N-3 LCPUFA supplementation	Both	high
24	Makrides et al. [2014]	Nutrition Specific	Magnesium supplementation	Both	High

The following sections are organised according to the intervention types and its impact on reducing the LBW rates.

No.	Intervention	Positive impact	No impact
1	Multiple micronutrient supplementation	√	
2	Iron supplementation		√
3	Zinc supplementation		√
4	Folic acid supplementation		√
5	Vitamin D supplementation	√	
6	Vitamin A and Carotenoids supplementation		√
7	Calcium supplementation		√
8	Vitamin C and E supplementation		√
9	Dietary intervention	√	

10	n-3 LCPUFA supplementation		√
11	Magnesium supplementation		√

3.3.1) Effect of multiple micronutrients supplementation on low birthweight

The reviews by Shah, (2009) and Ba & Za, (2016) examined the impact of multiple micronutrient supplementation versus placebo or with iron-folic acid supplementation to pregnant women within the urban settings. Supplementation was provided before and after 20 weeks of gestation, however the duration varied across the trials. Furthermore, multiple micronutrient supplementation was conducted throughout pregnancy on daily basis either through combining micronutrients or formulating a multiple micronutrient supplement providing 1 RDA of micronutrients according to UNIMMAP formulation (Kawai et al., 2011; Fall et al., 2009).

During the review it was evident that women supplemented with multiple micronutrients had lower risk of low birthweight children in comparison to women supplemented with placebo. Similar results were obtained when pregnant mothers were supplemented with iron-folic acid versus placebo (Shah, 2009). Additionally, Kawai et al., (2011), Fall et al., (2009); Ba and Za, (2016) *reported the importance of maternal multiple micronutrient supplementation in reducing the risk of low birthweight.*

A narrative review by Shrimpton et al., (2009) interpreted policy and programme implications during comparing results of multiple micronutrients versus daily iron-folic acid supplementation during pregnancy considering rural, semi-urban and urban context. Another narrative review assessed the impact of maternal multiple micronutrient supplementation in reducing the incidence of low birthweight along with other pregnancy outcomes (Zerfu and Ayele, 2013).

The authors observed significant increase in the mean birthweight among infants whose mothers received multiple micronutrient supplementations (Shrimpton *et al.,* 2009). *However, Zerfu et al. (2013) presented mixed impact of multiple micronutrient supplements in reducing the risk of low birthweight in LMICs*

Multiple Micronutrient supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Shah et al. [2009]	Pregnant women	Multiple micronutrient supplementations versus placebo or IFA (specific)	12	RCTs	Positive
2	Shrimpton et al. [2009]	Pregnant women	Multiple micronutrient supplementation (specific)	12	RCTs	Positive
3	Zerfu et al. [2013]	Pregnant women	Multiple micronutrient supplementation (specific)	3	RCTs + OTS	Mixed results

4	Fall et al. [2009]	Pregnant women	Multiple micronutrient supplementation versus control group (specific)	12	RCTs	Positive
5	Haider et al. [2016]	Pregnant women	Multiple Micronutrient Supplementation versus IFA (specific)	15	RCTs	Positive
6	Kawai et al. [2011]	Pregnant women	Multiple micronutrient supplementation versus IFA (specific)	15	RCTs	Positive

Reviewers Conclusion

Overall, the evidence from the SRs focusing on supplementation of multiple micronutrients containing iron and folic acid during pregnancy showed a positive impact in reducing low birthweight in LMICs.

Success and failure of the interventions

One of the authors suggested a few factors responsible for the success of multiple micronutrient supplementation in reducing low birthweight rates, which included the uninterrupted supply of supplements, and positive counseling of pregnant women along with counseling on adverse effects of supplements (Shrimpton et al., 2009).

3.3.2) Effect of oral iron supplementation on low birthweight

The reviews examined effect of oral iron supplementation or iron-folic acid versus no supplementation/placebo or iron-vitamins and minerals within pregnant women for the reducing low birthweight in children (Pena-Rosas and Viteri, 2006; Peña-Rosas et al., 2015; Peña-rosas et al., 2014). Duration and dosage of the intervention varied across the reviews.

The authors concluded no clear evidence of differences between women receiving daily iron, iron-folic acid versus placebo or no supplementation (Pena-Rosas and Viteri, 2006; Peña-Rosas *et al.*, 2015; Peña-rosas *et al.*, 2014). *Thus there was a lack of evidence to determine the evidence of routine oral iron supplementation in pregnancy in reducing the LBW rates.*

Oral Iron supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Pena-Rosas et al. [2006]	Pregnant women	Oral Iron supplementation (specific)	4	RCTs	No Impact
2	Peña-Rosas et al. [2015]	Pregnant women	Oral Iron supplementation (specific)	11	RCTs	No Impact
3	Peña-Rosas et al. [2012]	Pregnant women	Oral Iron supplementation (specific)	7	RCTs	No Impact

Reviewers Conclusion

The reviews indicate lack of evidence on the impact of oral iron supplementation to pregnant women in reduction of low birthweight.

Success and failure of the interventions

Although the authors from the included reviews did not show a conclusive impact of oral iron supplementation in reducing low birthweight rates, they mentioned few factors that could contribute to the success of these interventions such as encouraging the establishment of logistic procedures that facilitate and improve accessibility to supplements and foster compliance.

3.3.3) Effect of zinc supplementation on low birthweight

The authors evaluated impact of zinc supplementation on low birthweight (Chaffee and King, 2012; Erika Ota et al., 2015). The review focused on the zinc supplementation of pregnant zinc and was compared with the control group receiving identical supplements in at least one arm of the trial or placebo. The dosages varied from 5mg to 50mg zinc per day.

The authors found that maternal zinc supplementation had no impact on the risk of low birthweight between zinc and no zinc groups (Chaffee and King, 2012; Erika Ota et al., 2015).

Zinc supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Chaffee et al. [2012]	Pregnant women	Zinc supplementation versus comparison group receiving the identical supplements in at least one arm of the trial (specific)	11	RCTs	No Impact
2	Ota E et al. [2015]	Pregnant women	Zinc supplementation versus no zinc (specific)	14	RCTs	No Impact

Reviewers Conclusion

Overall, evidence from the above two reviews showed no impact of zinc supplementation in reducing rates of low birthweight. Further, the studies need to explore the overall public health benefits of zinc supplementation in pregnancy and its health outcomes.

3.3.4) Effect of folic acid supplementation on low birthweight

The authors assessed impact of folic acid supplementation on low birthweight (Saccone G, 2016; Lassi, Salam, et al., 2013). Dosage of the interventions varied across the reviews: Saccone G, (2016) - 5mg folic acid daily along with 200mg iron to intervention group and 200mg iron to control group; Lassi, Salam, et al., (2013) – 10 µg to 350 mg (along with multiple micronutrients); De-Regil et al., (2015) - 800 µg (0.8 mg) ; 2000 µg (2.0 mg) per day , 4000 µg (4.0 mg) per day. Pregnant mothers were supplemented before pregnancy until 12 weeks of gestation.

The authors concluded that the included reviews showed no impact of folic acid supplementation on the reduction of low birthweight rates.

Folic acid supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Saccone et al. [2016]	Pregnant women	Folic Acid Supplementation with iron (specific)	3	RCTs	No Impact
2	Lassi ZS et al. [2013]	Pregnant women	Folic Acid Supplementation (specific)	4	RCTS+ OTS	No Impact
3	De-Regil et al. [2010]	Pregnant women	Folic Acid Supplementation (specific)	1	RCTs	No Impact
4	De-Regil et al. [2015]	Pregnant women	Folic Acid Supplementation (specific)	2	RCTs	No Impact

Reviewers Conclusion

Overall, evidence from the review of reviews reflected no impact of maternal folic acid supplementation in improving the LBW rates.

3.3.5) Effect of Vitamin D supplementation on low birthweight

The review assessed the effects of vitamin D supplementation during pregnancy on neonatal outcomes (Pérez-López et al., 2015). The authors considered standard prenatal multivitamins containing 400 IU of vitamin D3. They evaluated vitamin D supplementation alone and in combination with calcium and vitamin supplements on pregnancy outcomes. However, when corroborated the results it was observed that the dosage of interventions varied across the reviews (De-Regil et al., 2016). Participants were supplemented daily doses varying from 200IU vitamin D to 2000IU for the period of 20 weeks of pregnancy and more. In the review maternal supplementation of daily 800 IU D2 to 2, 00,000 IU D2 from 28 weeks of gestation until delivery was reported (Throne-Lyman and Fawzi, 2012).

The authors found no impact of maternal vitamin D supplementation on the reduction of low birthweight (Pérez-López *et al.*, 2015). *Whereas other two reviews showed positive evidence for the supplementation of Vitamin D during pregnancy on reducing the prevalence of low birthweight* (De-Regil *et al.*, 2016; Lyman, 2012).

Vitamin D supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	López et al. [2015]	Pregnant women	Vitamin D Supplementation (specific)	13	RCTs	No Impact
2	De-Regil LM et al. [2016]	Pregnant women	Vitamin D supplementation (specific)	4	RCTs	Positive
3	Lyman et al. [2012]	Pregnant women	Vitamin D Supplementation (specific)	3	RCTs + OTS	Positive

Reviewers Conclusion

Overall evidence from the reviews demonstrated a positive impact of maternal vitamin D supplementation through increase weight of the babies. However, rigorous randomised trials are required to confirm the effect.

3.3.6) Effect of Vitamin A and Carotenoids supplementation on low birthweight

The Lyman, (2012) assessed vitamin A (VA) and carotenoids supplementation during pregnancy on neonatal and infant health outcomes. The dosage and form of supplements varied across the studies from a weekly dose providing the equivalent of a daily dose of 3333 IU VA to 10,000 IU per day.

The overall effect of Vitamin A on very low birthweight (<2.0kg) was null and that for low birthweight (<2.5 kg) was null but had a trend towards significance. The subgroup studies conducted in HIV positive populations showed a significant reduction in risk of low birthweight. Hence, supplementation may reduce the risk of LBW among HIV positive women although in areas of high HIV prevalence these benefits should be weighed against the potential risk of increased transmission from mother to child.

Vitamin A and Carotenoids supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lyman et al. [2012]	Pregnant women	Vitamin A and Carotenoids (specific)	5	RCTs	No Impact

Success and failure of the interventions

A review explained limited ability to identify sources of heterogeneity due to a small number of published studies. Also, different forms of vitamin A might have varied effects depending on the extent of deficiency and other contextual factors, which could be a few factors leading to the inconclusive impact of the intervention in reducing low birthweight rates.

3.3.7) Effect of Calcium supplementation on low birthweight

The review conducted by Buppasiri et al., (2015) supplemented pregnant women with calcium to improve pregnancy and infant outcomes. The supplementation was compared amongst the treatment and placebo/no treatment control group in varied forms such as calcium carbonate, calcium gluconate, calcium lactate and combined calcium.

The authors found no significant prospective effect of calcium supplementation on low birthweight. However, greater heterogeneity was observed in women who received a high dose. Thus, no clear beneficial evidence was indicated to maternal calcium supplementation in reduction of prevalence in low birthweight.

Calcium supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Buppasiri et al. [2015]	Pregnant women	Calcium Supplementation (specific)	6	RCTs	No Impact

3.3.8) Effect of Vitamin C and E supplementation on low birthweight

The meta-analysis by Rahimi et al. (2009) examined the effects of combined Vitamin C and E on low birthweight. The supplementation was provided to pregnant women with daily dosage of 1000mg vitamin C and 400IU vitamin E.

The authors concluded a significant relative risk for the outcome; however, when the impact was assessed the studies from LMICs no significant results on increasing birthweight was observed.

Vitamin C and E supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Rahim et al. [2009]	Pregnant women	Vitamin C and E Supplementation (specific)	3	RCTs	No Impact

3.3.9) Effect of Dietary intervention on low birthweight

The review by Gresham et al., (2014) assessed the effects of dietary interventions before or during pregnancy on the neonatal and infant outcomes. Randomized control trials segregated dietary interventions as: counselling, food and fortified food products, a combination (counselling plus food) intervention and collectively for all dietary interventions. These interventions during pregnancy ranged from 10 weeks to <40 weeks.

The author's showed a significant reduction in the incidence of low birthweight. The data used for the review had slight heterogeneity and no evidence of bias. The combination of nutrition education with fortified food products to pregnant women from LMICs is likely to increase size of infant at birth along with important health and financial ramifications.

Dietary supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Gresham et al. [2014]	Pregnant women	Dietary Interventions (specific)	10	RCTs + OTS	Positive

Success and failure of the interventions

Gresham et al. (2014) concluded during the review that pregnant mothers who are underweight and nutritionally at high risk and fed with fortified food products is the best strategy to increase infant birthweight.

3.3.10) Effect of n-3 LCPUFA (Long chain polyunsaturated fatty acids) supplementation on low birthweight

Imhoff-Kunsch et al., (2012) summarized the evidence of n-3 LCPUFA consumed by pregnant mothers and its outcomes on children. The intervention was started in the second trimester of pregnancy until delivery with doses of DHA ranged from 80 mg/day to 2.2 g/day.

The author could not find a significant difference in the low birthweight outcome between the supplemented and unsupplemented/ placebo groups even though babies included in n-3 LCPUFA group were heavier.

n-3 LCPUFA supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Kunsch et al. [2012]	Pregnant women	n-3 LCPUFA supplementation (specific)	8	RCTs	No Impact

Success and failure of the interventions

The author listed factors leading to inconclusive impact of maternal n-3 LCPUFA supplementation on low birthweight such as: variation in types of n-3 LCPUFA, duration, doses and the vehicle in which the n-3 LCPUFA was supplemented (Imhoff-Kunsch et al., 2012).

3.3.11) Effect of Magnesium supplementation on low birthweight

The review by Makrides and Crowther, (2014) supplemented magnesium in pregnant women to assess its impact on low birthweight. The composition of magnesium supplements, gestational age at the commencement of supplementation and doses administered varied across the studies.

The authors revealed no significant difference in the incidence of low birthweight between the magnesium supplemented and placebo groups.

Magnesium supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Makrides et al. [2014]	Pregnant women	Magnesium supplementation (specific)	6	RCTs	No Impact

Overall conclusion

The review of reviews showed that the prevalence of low birthweight could be potentially improved through maternal supplementation of vitamin D, multiple micronutrients or the use of fortified foods, and dietary interventions that used a combination of nutrition education and the use of fortified foods. Pregnant women from low resource settings who have inadequate intakes of micronutrients and energy intakes may benefit from such interventions. The majority of pregnant women from the LMICs enter pregnancy with inadequate stores of micronutrients and with underweight; supplementation with adequately fortified foods products with nutrition education may support optimal birth outcomes.

3.4 Breastfeeding

Of the total 61 included reviews, 6 (10%) reviews examined the impact of various nutrition interventions in improving the rates of breastfeeding. Of the 6 included reviews, 4 were

synthesized using meta-analysis; one being narrative review and one used mixed synthesis (meta-analysis and narrative review). All the included reviews belonged to nutrition specific interventions. The interventions included: Community intervention (n=5) and Kangaroo mother care (n=1).

The evidence presented in subsequent sections on impact in improving the rates of breastfeeding, is derived from 2 high quality, 3 medium quality and 1 low quality study (Total 6 SRs).

No	Authors	Nature of intervention	Intervention	Income Group	AMSTAR Rating
1	Sudfeld et al. [2012]	Nutrition Specific	Peer support and exclusive breastfeeding	LMICs	Medium
2	Renfrew et al. [2014]	Nutrition Specific	Extra support for exclusive breastfeeding	Both	High
3	Escamilla et al. [2012]	Nutrition Specific	Breastfeeding promotion programme “Breastfeeding Gear” Model	LMICs	Low
4	Hall [2011]	Nutrition Specific	Community based intervention	LMICs	Medium
5	Delgado et al. [2013]	Nutrition Specific	Promotion of exclusive breastfeeding	LMICs	Medium
6	Boundy et al. [2016]	Nutrition Specific	Kangaroo mother care	Both	High

The following sections are organised by intervention types for which the evidence of increase in prevalence of breastfeeding rates is made clear.

No	Interventions	Positive impact	No impact
1	Community interventions for the promotion of EBF	√	
2	Kangaroo mother care	√	

3.4.1) Effect of community interventions for the promotion of exclusive breastfeeding

The review conducted by Sudfeld, Fawzi and Lahariya, (2012) and Kawai et al., (2011) evaluated impact of peer support in promoting breastfeeding. The number of visits scheduled under peer support methods (one-to-one vs. group support) ranged from 1 to 10 visits conducted during the antenatal period to six months postpartum. Another review intervened peer support via proactive/indirect, one-to-one/group, professionals/lay supporters and training in breastfeeding support (Renfrew et al., 2014). Similarly, review synthesized using mixed approach (meta-analysis and narrative) by Delgado and Matijasevich, (2013) also examined peer support in promoting exclusive breastfeeding. Breast feeding promotion programme under “Breastfeeding Gear” model of WHO was evaluated in the narrative review conducted by Model et al., (2012). The participants included in all four reviews were women breastfeeding their babies. Hospital based- peer support approach was used in urban settings in these four reviews.

The authors concluded that peer support in promoting exclusive breastfeeding showed explicit improvement in the rates of exclusive breastfeeding in all four reviews.

The review conducted by Hall (2011) assessed community based intervention in terms of home based peer counselling, education support and follow up. Duration of the intervention varied from 4 months to 24 months.

The authors concluded that community based interventions were associated with an almost six-fold increase in the rates of exclusive breast feeding at four months compared with the usual care.

Community intervention for the promotion of exclusive breastfeeding						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Sudfeld et al. [2012]	Lactating mother	Peer support and exclusive breastfeeding	6	RCTs	Positive
2	Renfrew et al. [2014]	Lactating mother	Peer support and exclusive breastfeeding	40	RCTs	Positive
3	Escamilla et al. [2012]	Lactating mother	Breastfeeding promotion programme "Breastfeeding Gear" Model	5	RCTs + OTS	Positive
4	Hall [2011]	Lactating mother	Community based intervention	4	RCTs	Positive
5	Delgado et al. [2013]	Lactating mother	Peer support and exclusive breastfeeding	11	RCTs + OTS	Positive

Reviewers Conclusion

Overall, the evidence derived from the reviews showed positive impact of community and hospital based peer support in promoting exclusive breastfeeding amongst lactating mothers to improve the rate of exclusive breastfeeding.

Success and failure of the interventions

A review highlighted a few factors responsible for successful planning of peer support programme to improve exclusive rates such as taking into account cultural context and uniformity of EBF messages and integration of supplemental interventions (Sudfeld et al*.;* 2012). Also, peer support strategies that depend mainly on face-to-face support and those reflecting local needs of the population are found to be more effective (Renfrew et al.; 2014).

3.4.2) Effect of kangaroo mother care (KMC) on exclusive breastfeeding

The randomised controlled trials and other observational studies conducted by Boundy et al., (2016) studied the association between kangaroo mother care and its neonatal outcomes. The

participants included in the review were lactating mothers and intervention was examined considering urban context.

The authors concluded that KMC provided an increased likelihood of exclusive breastfeeding in infants. Also, at 1 to 4-month follow-up kangaroo mother care increased the rates of exclusive breastfeeding by 39% though did not have an impact on the mean difference in time to breastfeeding.

Kangaroo Mother Care						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Boundy et al. [2016]	Lactating mother	Kangaroo mother care	17	RCTs + OTS	Positive

Overall conclusion

To sum up, the review of SRs that addressed interventions to promote EBF showed that community-based interventions via peer group counselling and Kangaroo Mother Care considerably promoted EBF rates. It may be a prudent approach to include the above two important interventions through community health centres to improve the EBF rates in the Southeast Asian countries with a focus to initiate breastfeeding within hour of delivery.

3.5 Wasting

Of the total 61 included SRs, 18 (29.5%) reviews examined the effect numerous nutrition interventions on the reduction in wasting (weight for height) outcomes. Of the 18 included reviews, 16 reviews were synthesised using meta-analysis, while 2 were narrative reviews. A majority of the included reviews were nutrition specific interventions (n=14) while 4 reviews focused on nutrition-sensitive interventions. The nutrition specific interventions: Multiple micronutrient (n=4), zinc (n=3), supplementary feeding (n=2), prevention and treatment of acute malnutrition (n=2), dietary diversity and complementary feeding (n=1), iron (n=1). Nutrition sensitive interventions: Agricultural interventions, (n=2), WASH (n=1), combined interventions (n=1), school feeding programme (n=1).

The evidence presented in subsequent sections on impact in reducing the rates of wasting (weight for height) is derived form 11 high quality, 6 medium and 1 low quality studies (Total 18 SRs).

Table: Overview of included reviews for wasting as an outcome

No	Authors	Intervention type	Intervention	Income Group	AMSTAR Rating
1	Das et al. [2013]	Nutrition Specific	Multiple Micronutrient	Both	High
2	De-Regil et al. [2011]	Nutrition Specific	Multiple Micronutrient	LMICs	High
3	Wie-Ping et al. [2014]	Nutrition Specific	Multiple Micronutrient	LMICs	Medium
4	Ramakrishnan et al. [2009]	Nutrition Specific	Multiple Micronutrient	Both	Medium

5	Mayo Wilson et al. [2014]	Nutrition Specific	Zinc supplementation	Both	High
6	Nissensohn et al. [2014]	Nutrition Specific	Zinc supplementation	Both	Medium
7	Ota et al. [2015]	Nutrition Specific	Zinc supplementation	Both	High
8	Kristjansson et al. [2015]	Nutrition Specific	Supplementary feeding	LMICs	High
9	Sguassero et al. [2012]	Nutrition Specific	Supplementary feeding	LMICs	High
10	Lazzerini et al. [2013]	Nutrition Specific	P & T of acute malnutrition	LMICs	High
11	Schoonees et al. [2013]	Nutrition Specific	P & T of acute malnutrition	LMICs	High
12	Lassi et al. [2013]	Nutrition Specific	Dietary diversity and CF	LMICs	Medium
13	Sachdev et al. [2005]	Nutrition Specific	Iron supplementation	Both	High
14	Dangour et al. [2013]	Nutrition Sensitive	WASH	LMICs	High
15	Masset et al. [2012]	Nutrition Sensitive	Agricultural interventions	Both	High
16	Girard et al. [2012]	Nutrition Sensitive	Agricultural interventions	LMICs	Medium
17	McGregor et al. [2014]	Nutrition Specific	Combined interventions	LMICs	Medium
18	Lawson et al. [2012]	Nutrition Sensitive	School feeding programme	Both	Low

Note: CF – complementary feeding, P & T – prevention and treatment, WASH – water, sanitation and hygiene

The following sections are organised by intervention types for which the evidence of reduction in the wasting rates is made clear:

No.	Intervention	Positive impact	No impact	Mixed impact
1	Multiple micronutrient fortification/supplementation		√	
2	Zinc supplementation		√	
3	Supplementary feeding		√	
4	Prevention and treatment of acute malnutrition			√
5	Dietary diversity and complementary feeding			√
6	Iron supplementation		√	
7	WASH		√	
8	Agricultural intervention		√	
9	Combined intervention		√	
11	School feeding programme			√

3.5.1) Effect of multiple micronutrient fortification/supplementation on wasting

Of the total included 18 SRs, 4 reviews focused on the impact of multiple micronutrients for the improvements in the prevalence of wasting [weight for height] outcome. Of these 4 reviews, 2 reviews focused on multiple micronutrient fortification of various food vehicles such as condiments, powders and staples (Das et al., 2013; De-Regil et al., 2014). The fortified

foods were supplemented to children ≤ 15 years for the duration of 3 months to 4 years. The rest of the two reviews focused on supplementation of multiple micronutrients to children through targeted intervention to reduce prevalence of wasting (Lu et al., 2014; Ramakrishnan, Nguyen and Martorell, 2009). One review evaluated the effectiveness of UNIMMAP, developed by UNICEF and the other review used three or more micronutrients. The control used varied across the studies from supplementation with two or fewer micronutrients or placebo or no supplementation. Target population was children ≤5 years and duration varied from 5 – 32 weeks.

Multiple Micronutrient fortification						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Das et al. [2013]	Children ≤ 15 years	Multiple Micronutrient fortification	8	RCTs+ OTS	No impact
2	De-Regil et al. [2014]	Children ≤2 years	Home (point of use) fortification of food with MNP	2	RTCs	No impact

Multiple Micronutrient supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Wie-Ping et al. [2014]	Children ≤5 years	Multiple Micronutrient Supplementation	4	RCTs	No impact
2	Ramakrishnan et al. [2009]	Children ≤5 years	Multiple Micronutrient Supplementation	Vit A – 17 Iron – 27 Zinc – 43 MM - 20	RCTs	No impact

Authors concluded that there is no evidence on the impact of multiple micronutrient supplementation or fortification on the prevalence of wasting.

Reviewers Conclusion

Overall evidence from the SRs suggests no impact of multiple micronutrient fortification/supplementation on the rates of wasting. Detailed evaluations of direct impact of multiple micronutrient fortification/supplementation on anthropometric measures are required to plan effective strategies for the future. The side effects associated with multiple micronutrient home fortification needs to be explored in more depth with in settings where infection and malnutrition are common.

Success and failure of the interventions

The included review used variety of foods and concentrations of micronutrients, and the frequency of feeding/intake was not uniform making it difficult compare across the reviews.

There was limited information available on confounding factors like age and nutritional status at the initiation of the intervention which limited inference of outcomes by age bands and nutrition categories, and the duration of the intervention period evaluated varied across the reviews. These could be potential factors that might confound the impact of multiple micronutrient fortification on wasting rates (Das et al., 2013). Another review explained factors responsible for inconclusive impact of multiple micronutrient supplementation on wasting such as inadequate follow up time; limited information on confounding factors like baseline nutritional status of mothers, social economic status of family, and feeding patterns during infancy (Wie-Ping et al., 2014).

3.5.2) Effect of zinc supplementation on wasting

A total of 3 SRs were included for the wasting outcome (Mayo-Wilson et al., 2014; Nissensohn et al., 2016; E Ota et al., 2015). Target population was children ≤ 60 weeks. The intervention was provided to target population in the form of supplements. Supplementation dosage varied across the studies from 1.78 – 44 mg/day for the duration until 60 weeks.

During the meta-analytic review, two authors concluded the zinc supplementation had no impact on wasting. However, on the contrary results obtained in one review (Nissensohn et al., 2016) *showed a positive impact with a statistically significant effect of zinc on weight-for-length. The review had only one study that evaluated the impact of zinc supplementation and thus, need more studies to have conclusive evidence.*

Zinc supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Mayo Wilson et al. [2014]	Children 6 months to 12 years	Zinc supplementation and additional iron	24	RCTs	No impact
2	Nissensohn et al. [2014]	Children ≤36 months	Zinc supplementation	8	RCTs	Positive
3	Ota et al. [2015]	Neonates and infants	Zinc supplementation versus no zinc supplementation	1*	RCTs	No impact

*The SR has assessed the impact of Zinc supplementation on multiple anthropometric indicators of neonates and infants. Only one study addressed the impact on weight-for-height.

Reviewers Conclusion

Overall evidence suggests that there is no conclusive evidence to prove the effect of zinc supplementation in relation to positive linear growth.

Success and failure of the interventions

A review could not identify any effective strategies for delivering zinc supplements considering dose, formulation and frequency, which might have had positive impact on wasting. The authors found the need to identify the main effects and explore how zinc administration (separate/combine) affects uptake and costs (Evan Mayo-Wilson et al. *2014*).

3.5.3) Effect of supplementary feeding on wasting

Two reviews reported the impact of supplementary feeding on wasting rates (Kristjansson et al., 2015; Sguassero et al., 2012). The authors supplemented ready-to-use therapeutic foods (RUTF) with or without other foods and supplementary feeding such as energy protein supplementation and multi mixture food products for the duration of average period of 6 months in RCTs, 8 months during controlled before and after study and less than 12 months. The participants included in both the reviews were children 3 to 5 years (Kristjansson et al., 2015) and children older than 24 months (Sguassero et al., 2012).

Authors concluded that supplementary feeding intervention did not show statistically significant results on the prevalence of wasting.

Supplementary Feeding						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Kristjansson et al. [2015]	Children 3 - 5 years	Food supplementation (RUTF with or without other foods, sweetened condensed milk, powdered milk or milk based formula, vegetables, fruits, lentils)	7	RCTs+OTS	No impact
2	Sguassero et al. [2012]	Children ≤ 2 years	Supplementary feeding (energy protein supplementation, multi mixture)	1*	RCTs	No impact

*The SR has assessed the impact of supplementary feeding on multiple anthropometric indicators of children aged less than 2 years. Only one study addressed the impact on weight-for-height.

Reviewers Conclusion

Overall evidence indicates no impact of supplementary feeding intervention on wasting in LMICs.

Success and failure of the interventions

One of the two authors mentioned the inconclusive impact of supplementary feeding on wasting; they indicated potential failure factors such as breakdown in supply chain leading to failure in delivery of feeding to family, and disruption of breastfeeding (Kristjansson et al. 2015).

3.5.4) Effect of prevention and treatment of acute malnutrition on wasting

The review conducted by Lazzerini, Rubert and Pani, (2013) and Schoonees *et al.*, (2013) compared standard care vs supplementation with specially formulated foods (i.e. lipid-based nutrient supplements versus blended foods; lipid based nutrient supplementation versus specific types of blended foods; and RUTF versus standard diet (flour porridge)) on children between 6 months to five years.

Schoonees et al. (2013), concluded that there was no difference in weight-for-height z-score between RUTF and standard diet group. The authors did not report gain in weight-for-height z-score because exact P value of the difference between the changes in each group were not reported. However, the study conducted by Lazzerini, Rubert and Pani, (2013) reported a gain in weight-for-height z-score in groups receiving specially formulated foods, lipid based nutrient supplementation in comparison to standard care and blended foods.

Prevention and treatment of acute malnutrition						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lazzerini et al. [2013]	Children 6 months to 5 years	Specially formulated foods for children with MAM (specially formulated foods, standard care, lipid based nutrient supplements, blended foods)	2	RCTs+ OTS	Positive
2	Schoonees et al. [2013]	Children 6 months to 5 years	Home based RUTF	1*	RCTs	No impact

*The SR has assessed the impact of prevention and treatment of acute malnutrition on multiple anthropometric indicators of children aged between 6 months to 5 years. Only one study addressed the impact on weight-for-height.

Reviewers Conclusion

Overall evidence from both the SRs did not provide concrete evidence to show the impact of intervention via prevention and treatment of acute malnutrition on wasting. Although one of the two SRs showed a positive impact, there was only one study that evaluated the weight-for-height z-score and hence, more such studies are needed for developing conclusive evidence.

Success and failure of the interventions

One of the two reviews mentioned a few factors leading to inconclusive impact of home based RUTF on wasting including a lack of information on participants total daily energy intake as per group as well as the likelihood of sharing RUTF and standard diet with family and whether something was done to prevent differential sharing, not evaluated potential long-term growth and developmental differences (Schoonees et al. 2013).

3.5.5) Effect of dietary diversity and complementary feeding on wasting

Lassi et al., (2013) conducted a review on children less than two years of age and provided complementary feeding and education on complementary feeding to food secure and insecure populations. Interventions were broadly classified as education on complementary feeding and complementary feeding with or without nutrition education.

The authors concluded that the pooled analysis showed a significant impact of nutritional education on weight-for-height z-scores. On the contrary, authors found that complementary

feeding with or without nutrition education had no impact on weight-for-height z-scores. Thus, the evidence from the review highlights importance of complementary feeding interventions in improving the nutritional status despite the fact that results were highly heterogeneous.

Dietary diversity and complementary feeding						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lassi et al. [2013]	Children 6 months to 2 years	Education intervention on complementary feeding, complementary feeding with or without nutritional education	Education: 4, CF with or without education: 2	RCTs+OTS	Education intervention: Positive, CF with or without nutritional education: No impact

Reviewers Conclusion

Nutrition education intervention on complementary feeding had a positive impact when compared to complementary feeding without nutrition education. The available evidence from the review suggested that in food insecure populations, education should be accompanied with provision of affordable yet effective complementary foods (Lassi et al. 2013). Accelerated and concerted actions are required to deliver and scale up nutrition education and complementary feeding provision interventions that are cost-effective, feasible and effective in improving the nutritional status of children.

3.5.6) Effect of iron supplementation on wasting

The review conducted by Sachdev, Gera and Nestel, (2006) assessed the impact of iron supplementation on weight-for-height z-score of infants, toddlers and older children. Oral medicinal iron supplementation was provided and in few studies fortified foods were used. The duration of the supplementation ranged from <3 months to longer.

The authors of the review concluded that the pooled mean estimates of the standardised difference of change in wasting between the iron supplemented and control groups were not statistically significant. Thus, supplementation did not show a positive effect on wasting require further confirmation, hence, inconclusive impact.

Iron supplementation						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Sachdev et al. [2006]	Infants, toddlers, older children	Iron supplementation	7	RCTs	No impact

3.5.7) Effect of WASH intervention on wasting

The review conducted by Dangour et al., (2013) examined the effect of WASH interventions on weight-for-height z-score. The authors compared improvement of WASH to control group

for the duration ranged from 6 to 60 months. The participants included in the review were children under five years of age.

The authors found no evidence of the effect of WASH intervention on weight-for-height z-score, no heterogeneity was observed between the studies.

WASH						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Dangour et al. [2013]	Children under 5 years	WASH	10	RCTs+OTS	No impact

Reviewer conclusion

The authors indicated the lack of evidence on intervention adherence, attrition and costs, long-term studies on WASH interventions and its impact on childhood nutrition outcomes including wasting (Dangour et al., 2013).

3.5.8) Effect of agricultural interventions on wasting

In their review Edoardo Masset et al., (2012) focused on production diversification and bio-fortification projects of agricultural interventions and assessed the efficacy of the interventions on children's nutritional status. Another review (Girard et al., 2012) studied the effects of household food production on the nutrition and health outcomes of women and young children residing in rural and urban areas.

The two SRs showed no evidence of impact on the prevalence rates of wasting among children less than five years of age.

Agricultural interventions						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Masset et al. [2012]	Children	Agricultural interventions	7	RCTs	No impact
2	Girard et al. [2012]	Children 0-59 months	Agricultural interventions to improve household food production	4	RCTs+OTS	No impact

Reviewer Conclusion

Overall agricultural strategies had no impact on the wasting prevalence. Further research with robust research designs would support to understand the impact of agricultural interventions on nutritional outcomes. The factors that were found to be associated with agricultural intervention programmes included production of foods that were rich sources of both micro- and macronutrients such as energy and/or protein, and crop production strategies that promoted OFSP and legumes or included animal production strategies.

3.5.9) Effects of combined interventions on wasting

One of the review examined the effect of combination of child development and nutrition interventions through RCTs and programmes implemented (Grantham-Mcgregor et al., 2014).

The effects of nutrition interventions on weight-for-height z-scores remained the same when child development intervention (simulation) was added. The review did not provide combined effects of nutrition intervention in improving weight-for-height z-cores- however, provided details of included studies together with individual effect sizes. Overall evidence was lacking.

Combined interventions						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	McGregor et al. [2014]	Children	Micronutrient, macronutrient, nutrition education and breastfeeding promotion	5	RCTs+ OTS	No impact

3.5.10) Effect of school feeding programme on wasting

One review focused on the school feeding programme to see its effect on wasting (Lawson, 2012). Interventions included in the review were school feeding programme in the form of meal, snacks, and beverages; and Take Home Rations (THR), duration of which ranged from 4 months to 24 months on participants of age group from 3-15 years and siblings from 12-60 months in one of the study.

The review showed overall mixed effect on wasting considering school feeding programme as intervention. It showed no significant results when students received school meals, but showed positive effects when snacks or beverages were used as intervention. Whereas, in THR programmes- wasting saw gains and larger decrease in wasting prevalence even in their siblings when THR were available for households. Methodological quality of this review based on AMSTAR score is low, hence evidence generated should be cautiously considered.

School Feeding programme						
No	**Authors**	**Population**	**Intervention (type)**	**Included studies**	**Study Design**	**Impact**
1	Lawson et al. [2012]	School children	School feeding programme	6	RCTs+ OTS	Mixed

Success and failure of the interventions

The author of the review indicated a few factors leading to inconclusive effectiveness of school feeding programme on nutritional status of children- measures of cost effectiveness, issues of sustainability and impact on local agricultural development, issues of implementation of the programme in terms of logistic challenges, interruptions in food delivery, and food being given to untargeted children or students (Lawson, 2012).

Overall conclusion

Among the diverse interventions that were conducted to improve the wasting rates, none of the interventions showed a positive impact. Three interventions showed mixed impact

namely, prevention and treatment of acute malnutrition, dietary diversity and complementary feeding together with nutrition education and the school feeding programme. Logically, it would be meaningful to have a combination of these three interventions: Firstly, to treat the wasted children at the nutrition rehabilitation centres under medical supervision; Secondly, upon improvement provide nutrient education to diversify their diets and complementary feeding while at home using locally produced nutrient rich foods; and finally, through their enrolment for the school feeding programme where nutritious snacks and beverages could be provided. Such a strategy may provide these wasted children with an opportunity to catch up their growth through a continuum of nutritional care.

URBAN SETTING

Is there review-level evidence of effectiveness of nutrition interventions specific to urban settings in LMICs? If so, what are the key characteristics of successful nutrition intervention programmes delivered in urban settings?

There has been a considerable rise in the urban dwelling populations in LMICs and majorities migrate to the urban areas in search of employment opportunities and living. However, the urban areas are thickly populated to accommodate the growing demands of shelter, and better living conditions for the migrating populations. Poor living conditions coupled with inadequate access to good food and nutrition, predispose them to a variety of health and nutrition issues. So the present evidence summary evaluated the effectiveness of the existing interventions and programmes tailored to urban settings of LMICs.

Of the 61 included SRs, we did not find any review level evidence focusing specifically on urban settings in LMICs. A few authors had oriented their results to examine the effectiveness of nutrition interventions on WHA outcomes for urban settings. However, while extracting data from the included 61 SRs, we came across 16 SRs (26%), which examined the impact of nutrition-specific and sensitive interventions on the urban, rural and semi urban setup for WHA outcomes. Of which, five SRs focused on promotion of exclusive breastfeeding, One SR in Anaemia, two SRs on LBW, seven SRs on stunting, and six SRs on wasting.

The details of SRs focused on the mixed set-ups (i.e. rural and urban) are mentioned below, impact shown in the table implies overall impact of the intervention, as none of the author examined effectiveness of nutrition interventions with relevance to urban settings of LMICs.

No	Authors	Intervention	Outcome	Impact
1	Sudfeld et al. [2012]	Peer support and exclusive breastfeeding (specific)	EBF	Positive
2	Renfrew et al. [2014]	Extra support for exclusive breastfeeding (specific)	EBF	Positive
3	Hall [2011]	Community based intervention (specific)	EBF	Positive
4	Boundy et al. [2016]	Kangaroo mother care (specific)	EBF	Positive
5	Delgado et al. [2013]	Promotion of exclusive breastfeeding (specific)	EBF	Positive
6	Low MSY et al. [2016]	Iron supplementation (specific)	Anaemia	Positive
7	Shrimpton et al. [2009]	Multiple micronutrient supplementation (specific)	LBW	Positive
8	Chaffee et al. [2012]	Zinc supplementation versus comparison group receiving the identical supplements (specific)	LBW	No impact
9	Devakumar et al. [2016]	Multiple Micronutrient supplementation (specific)	Stunting	No impact

10	Manley et al. [2012]	Cash transfer (sensitive)	Stunting	No impact
11	Sguassero et al. [2012]	Supplementary feeding (specific)	Stunting, Wasting	No impact
12	Kristjansson et al. [2015]	Supplementary feeding (specific)	Stunting, Wasting	Positive
13	Lawson [2012]	School feeding programme (sensitive)	Stunting, Wasting	Mixed results
14	Dangour et al. [2013]	WASH (sensitive)	Stunting, Wasting	No impact
15	Girard et al. [2012]	Agricultural intervention (sensitive)	Stunting, Wasting	No impact
15	Lassi et al. [2013]	Education intervention on complementary feeding, complementary feeding with or without nutritional education (specific)	Wasting	Mixed result

The results indicate that all the five SRs showed a positive impact of different interventions such as peer group support, community-based interventions, Kangaroo mother care and promotion of exclusive breastfeeding on exclusive breastfeeding. Iron supplementation was found to be effective in reducing the prevalence of anaemia in women of reproductive age. One out of the two studies that focused on multiple micronutrient supplementations showed a positive impact on the prevalence of LBW. On the other hand, five out of seven studies showed no impact of interventions on the stunting prevalence. Supplementary feeding was shown to have a positive impact while the school feeding programme was shown to have mixed results. In all five studies that assessed the impact of different interventions on wasting one showed positive impact (supplementary feeding), two SRs showed mixed impact (school feeding programme and education intervention on complementary feeding) and five interventions showed no impact on wasting prevalence.

The SRs that considered the WHA targets for the urban, rural and semi-urban settings showed inconclusive results and more studies specifically focussed to the urban settings are needed to strengthen the evidence for policy development for these populations. The health and nutrition challenges of urban populations are distinct and may require different approach to address the nutritional issues. Targeted nutrition interventions that are suitable to the different communities in the urban settings may be required to reduce the nutrition challenges of these populations.

4 Conclusion and Recommendations

This evidence summary was conducted to identify, critically appraise and provide an overview of review-level evidence on the effectiveness of nutritional interventions delivered in LMICs targeted at the WHA specified outcomes such as stunting, anaemia, low birthweight, exclusive breastfeeding and wasting. We found that 61 SRs examined the impact of various nutrition interventions on the above outcomes. Among the selected SRs, 30 SRs included studies exclusively from LMICs and the remaining 31 SRs included studies from both-LMICs and HICs. Regarding the quality of included SRs, 34 (56%) were of high, 22 (36%) were of medium and 5 (8%) were of low quality. Although a number of interventions were listed in the included SRs, the largest number (17) of SRs examined the impact of multiple micronutrients on various outcomes.

A brief summary of the key findings with respect to the effectiveness of various nutrition interventions on the WHA targeted outcomes are provided below:

Interventions with evidence of impact

Outcomes	Interventions
Stunting	1. Dietary diversity and complementary feeding practices
Anaemia	1. Iron supplementation during pregnancy 2. Use of iron fortified foods 3. Vitamin A and Carotenoids supplementation
EBF	1. Peer group led breastfeeding programmes 2. Community interventions for the promotion of EBF 3. Kangaroo mother care
LBW	1. Multiple micronutrient supplementation / food fortifications 2. Vitamin D supplementation to pregnant women 3. Dietary diversity and maternal supplementary feeding
Wasting	1. Nutrition education on complementary feeding practices (Mixed impact)

The effectiveness of nutrition interventions in reducing the prevalence of stunting

Approximately one-third (34%) of the SRs examined the impact of nutrition interventions on reducing the prevalence of stunting with the majority examining the impact of nutrition-specific interventions. Dietary diversity and complementary feeding were the interventions that had a positive impact on stunting among young children. The finding holds relevance considering the impact and the timing of these nutrition interventions (i.e. children <2 years). Young children are the most vulnerable for stunting and the right timing of introduction of these nutrition interventions are important. Food-based strategies to improve complementary feeding practices and dietary diversification would be a successful intervention to reduce the prevalence of stunting.

The two interventions that reported mixed results were supplementary feeding programme for children and the school feeding programme. Further studies and evaluation of new evidence could further strengthen the available evidence regarding the above two nutrition interventions on the stunting prevalence. Nutrition interventions that showed no impact on stunting included multiple micronutrient fortification/ supplementation, supplementation of iron, and zinc, specially formulated foods and ready to use therapeutic foods for home-based treatments, WASH practices, agricultural interventions, cash transfer programmes (conditional and non-conditional). Overall, the evidence suggests that dietary diversity and complementary feeding practices have a positive impact on linear growth. No significant effect was observed on linear growth when nutrition interventions were combined with child development interventions.

The effectiveness of nutrition interventions on anaemia among women of reproductive age

More than one-fourth (26%) of the SRs examined the impact of nutrition interventions on reduction of anaemia among women of reproductive age with the great majority using meta-analysis. All the reviews examined the impact of nutrition-specific interventions. The interventions that showed a positive impact on women of reproductive age LMICs included iron supplementation with or without folic acid and wheat flour fortification with iron, and supplementation of vitamin A or carotenoids. The findings have relevance to reproductive age women in LMICs especially when a majority of these women have inadequate vitamin A intakes and/or deficiencies of Vitamin A and iron. Studies have reported anaemia in subjects, despite supplementation of iron, when they were maintained on Vitamin A deficient diets and anaemia responded to Vitamin A supplementation (Hodges et al, 1978).

The SRs that evaluated the supplementation of folic acid, calcium, zinc, multiple micronutrient supplementation/ fortification, did not show any significant impact of these interventions on the reduction in the prevalence of maternal anaemia.

The effectiveness of nutrition interventions in improving the rates of exclusive breastfeeding (EBF)

Only one-tenth of the SRs (10%) examined the impact of interventions in improving the rates of breastfeeding with a great majority synthesising the evidence using meta-analysis. All the reviews examined the impact of nutrition-specific interventions such as community-based interventions, peer support and Kangaroo Mother Care (KMC). Community-based interventions and peer support had significant positive impact in improving the rates of exclusive breastfeeding. Also, KMC provided an increased likelihood of exclusive breastfeeding but did not have an impact on the mean duration of breastfeeding. Only limited information was available on the impact of these interventions on early initiation of breastfeeding post-delivery.

The effectiveness of nutrition interventions in reducing the rates of LBW

More than one-third (39%) of the SRs examined the impact of various nutrition interventions in reducing the rates of LBW with a great majority synthesising the evidence using meta-analysis. All the SRs examined the impact of nutrition-specific interventions. Overall, the

impact of interventions in pregnancy such as supplementation of multiple micronutrients containing iron and folic acid; Vitamin D supplementation; and dietary intervention showed a positive impact in reducing LBW in LMICs. However, no impact was found for supplementation of oral iron or zinc, calcium, Vitamin C and E, magnesium, and n-3 LCPUFA consumption in pregnant women. Although Vitamin A supplementation showed a small effect overall in reducing the prevalence of LBW, subgroup studies conducted in HIV positive populations showed a significant reduction in risk of LBW.

The effectiveness of nutrition interventions in reducing the rates of wasting

More than one-fourth of the reviews (29.5%) of the SRs examined the impact of nutrition interventions on the reduction in wasting (weight-for-height) with many reviews synthesising the evidence using meta-analysis. The majority of the included reviews examined the impact of nutrition-specific interventions. Interventions that showed no impact on wasting included multiple micronutrient fortification/supplementation; zinc supplementation; iron supplementation; WASH interventions; agricultural interventions (diversification and bio-fortification projects); supplementary feeding intervention on wasting in LMICs. The effects of nutrition interventions on weight-for-height z-scores did not change significantly when child development intervention (simulation) was added.

The interventions that reported mixed impact on wasting included the following: Nutrition education had a significant impact on weight-for-height z-scores, prevention and treatment of acute malnutrition, and the school-feeding programme. Complementary feeding with or without nutrition education had a non-significant impact on weight-for-height z-scores. School feeding programmes showed no significant results when students received school meals but did show positive effects from interventions involving snacks or beverages. Methodological quality of this review based on AMSTAR score was low, hence evidence generated should be considered cautiously.

Effectiveness of nutrition interventions specific to urban settings in LMICs

Of the 61 included SRs, we did not find any review level evidence focusing specifically on urban settings in LMICs. A Few authors have oriented their results to examine the effectiveness of nutrition interventions on WHA outcomes for urban settings. In 16 SRs (26%), the impact of nutrition-specific and sensitive interventions on the urban, rural and semi urban setup for WHA outcomes have been examined. Among these reviews, five SRs focused on promotion of exclusive breastfeeding, one SR on Anaemia, two SRs on LBW, seven SRs on stunting, and six SRs on wasting. The SRs that considered the WHA targets for the urban, rural and semi-urban settings showed inconclusive results and more studies specifically focussed to the urban settings are needed to strengthen the evidence for policy development with respect to urban setting.

LIMITATIONS

This review has some limitations. Our focus on the WHA targeted outcomes would have resulted in the exclusion of a range of reviews that have reported impact of the interventions

on other potential outcomes that are intended to be achieved by the interventions. However, as suggested by the advisory group, this approach was deemed to produce more relevant and useful information to policy makers to address the key nutritional issues with a set of targets to be achieved by 2025.

The findings of our meta-review were drawn from findings and conclusions reported in SRs rather than individual studies. Although we have taken extreme caution to report the direction of impact accurately, the lack of adequate information in some SRs may have impacted the reliability and validity of our findings.

Our restriction to studies published in English might have led to exclusion of relevant papers published in local languages. Due to limited resources, we were also unable to explore any potential publication bias resulting from exclusion of unpublished studies or findings reported in grey literature.
Most of the systematic reviews included did not show any concrete conclusion pertaining to the impact of interventions on WHA target. Further, number of studies included in the reviews was less, which limit us to draw any conclusion. Disparities in methods of synthesis in the reviews exist. It was quite challenging to draw conclusion from the reviews, which included studies from developed countries and LMICs. The WHA targets were not primary objective in most of the reviews which was challenging for us to come up with concrete evidence from such reviews.

IMPLICATIONS

Based on the evidence summary result synthesis we draw the following implications for policymakers seeking to achieve the WHA nutrition targets by 2025.

For policy and practice:

Stunting

Evidence: Overall, the evidence suggests that nutrition education for improving dietary diversity and complementary feeding practices have a positive impact on linear growth (stunting reduction). No significant effect was observed on linear growth when nutrition interventions were combined with child development interventions.

Reduction in stunting requires to prioritise as this is a slow process and requires intense and sustainable programmes to address the same. Ensuring appropriate infant and young child feeding practices are important as the stunting sets in after the first 6 months of age in infants. Additionally, food based strategies to improve dietary diversification tailored to the regions or local communities could ensure food security among communities, which in turn will improve the dietary diversity and nutritional status of young children.

Implications: Review of reviews on the effectiveness of nutrition interventions on stunting prevalence (acute and chronic malnutrition) indicated that targeted efforts to promote dietary diversity; timely and adequate introduction of nutritious, locally prepared complementary

foods, and follow-up of complementary feeding practices during early childhood through nutrition counselling are essential, especially in low resource settings of LMICs. The above approach should be considered for implementation through community-based healthcare system where pregnant and lactating women could be counselled regarding the best practices in young child nutrition. The health department and women and child welfare or nutrition department should focus on these interventions and implement them properly for getting results.

Anaemia improvement

Evidence: The interventions of iron supplementation with or without folic acid and iron fortified wheat flour, and supplementation of vitamin A or carotenoids showed a positive impact on reduction in the prevalence of anaemia in reproductive age women from LMICs.

Implications: In LMICs where anaemia remains as a major public health challenge among women of reproductive ages, the existing anaemia control programmes should be strengthened with an emphasis on interventions such as supplementation of iron fortified foods; Vitamin A and Carotenoids supplementation; and on Iron supplementation for pregnant women.
In LMICs where such programmes are unavailable or sparse, interventions involving supplementation of Iron with or without folic acid could be introduced or up-scaled with provisions in accordance with internationally standardised guidelines (such as the WHO guidelines). LMICs with predominantly vegetarian populations could consider IFA supplementation and distribution of iron-fortified foods through public distribution system. Such programmes should focus on effective implementation strategies including availability, timely distribution and monitoring the consumption of these tablets. In populations where dietary intakes of vitamin A /carotenoids are low, supplementation of vitamin A might support reducing the prevalence of anaemia. Consumption of excess of iron from supplements should be discouraged, and smaller doses of iron may be considered together with the dietary diversification strategy for non-iron deficiency anaemic pregnant women.

In populations where dietary intakes of vitamin A /carotenoids are low, supplementation of vitamin A might support reducing the prevalence of anaemia. Vitamin A deficiency influences in the absorption and utilization of iron; thus, correction of vitamin A deficiency may improve the utilization of iron in the body (Michelazzo et al, 2013). This approach should be considered with caution for pregnant women as large dose supplementation of vitamin A in first trimester could have adverse effects on the fetus (WHO, 1998; Cruz et al, 2017). Smaller doses of vitamin A together with dietary diversification strategy to improve the vitamin A intake would reduce the prevalence of anaemia in reproductive age women. Additionally, ensuring the optimal vitamin A status before conception would improve the overall outcome of pregnancy and a reduction in the prevalence of anaemia.

For non-pregnant women of reproductive age and newly married women a single bolus dose of vitamin A (a massive dose as given in children) could be given through healthcare facility, if they are found deficient. The younger women (Non-pregnant women of reproductive age and newly married women) should be encouraged to ensure adequate intake of macro and

micronutrients through diets and to maintain appropriate weight. Nutrition counselling in optimising locally available nutritious foods to ensure dietary diversity and to meet daily requirements of nutrients through diets would immensely benefit women and their families. During pregnancy supplements (for example: iron and folic acid- iron 60 mg/day) as recommended by the WHO should be used; however, the duration of the use, dosage and adherence to the supplements should be regularly monitored and evaluated through their biochemical profiles. Finally, the dosage and frequency of use of these supplements should consider the dietary intakes of these nutrients and should not be above the recommended dietary allowances for the populations.

Exclusive Breastfeeding improvement

Evidence: The evidence synthesis from SRs showed conclusive evidence that promotion of exclusive breastfeeding (EBF) could be increased through peer group, community-based support and programmes.

Implications: Community based and peer-led interventions could be used as a strategy for the implementation of interventions to promote breastfeeding. Such programmes should focus on pregnant women prior to and immediately after delivery, and during the first 6 months of infant age. A community-based peer support system would be a less resource intensive, feasible for promotion of EBF. Additionally, implementation and integration of Kangaroo Mother Care (KMC) programme as a part of the healthcare programme post-delivery at the health facility level may promote EBF rates. Community-based peer led groups could support the new mothers through timely, adequate, nutritious, responsive and appropriate complementary feeding programme for infants >6 months until 2 years. This would support optimum development of young children who are weaned from breast milk to normal diet without adversely influencing their nutritional status.

Low birthweight (LBW) improvement

Evidence: The evidence from the summary regarding LBW interventions indicated that the prevalence of LBW could be reduced through multiple micronutrient supplementation containing IFA, vitamin D supplementation and dietary intervention strategies such as a combination of nutrition counselling and the use of fortified foods during pregnancy.

Implications: The existing IFA supplementation could be expanded to multiple micronutrients including vitamin D in LMICs where substantial proportion of pregnant women have multiple micronutrient deficiencies or have poor intakes of micronutrients. The health programmes should include dietary diversification strategies together with nutrition education to use locally available foods to improve the nutrient intakes and to support optimal weight gain during gestation. In HIV positive women supplementation of vitamin A had significant effect in reducing LBW.

Wasting:

Evidence for Wasting improvement: The interventions that reported **mixed impact** on wasting included the following: Nutrition education had a significant impact on weight-for-

height z-scores, prevention and treatment of acute malnutrition, and the school feeding programme. School feeding programmes showed no significant results when students received “school meals” but did show positive effects from interventions involving “snacks” or “beverages”.

Implications

Wasting should be prevented in normal children and treated if children are malnourished and subsequently should be supported with adequate nutrient rich foods to sustain their growth and development. Continued supplies of nutrients are important to improve the nutritional status and to prevent wasting in young children. Programmes addressing wasting in infants post breastfeeding and subsequently in young school children by improving the intakes of nutrients through school feeding programmes should strengthen using nutrient-rich snacks and beverages.

Overall, considering the available evidence from the review of reviews, it appears that young women of reproductive age group from LMICs, would benefit from multiple micronutrient supplementation and nutrition education on achieving dietary diversity through food-based approaches.

Implications of research

Despite having multiple studies and systematic reviews there remains substantial scope for further research and evidence building in the area of nutrition. The scope for further research exists in the following areas and requires more evidence to design new policies and programmes to address WHA targets:

- Information on duration, dosage and time of initiation of supplementation with micronutrients need to be further researched. For example, daily iron supplementation vs intermittent iron supplementation vs weekly iron supplementation during pregnancy and lactation should be rigorously evaluated in LMICs.
- Impact and effectiveness of community-based dietary diversification strategies using locally available nutritious foods to improve the health and nutritional status of women and children need to be ascertained.
- Surveillance systems to monitor and evaluate the health and nutritional status of pregnant, lactating women, neonates and young children should be developed and the effectiveness should be determined.
- Impact of pre-pregnancy nutrition and supplementation on pregnancy and child outcomes should be evaluated through effectiveness trials.
- Combinations of nutrition-specific and nutrition-sensitive approaches to improve the nutritional status of women and young children should be evaluated.
- The role of household food security on dietary diversification strategies, health and nutritional status of women and children could provide insights into the need for fortification and supplementation for communities.

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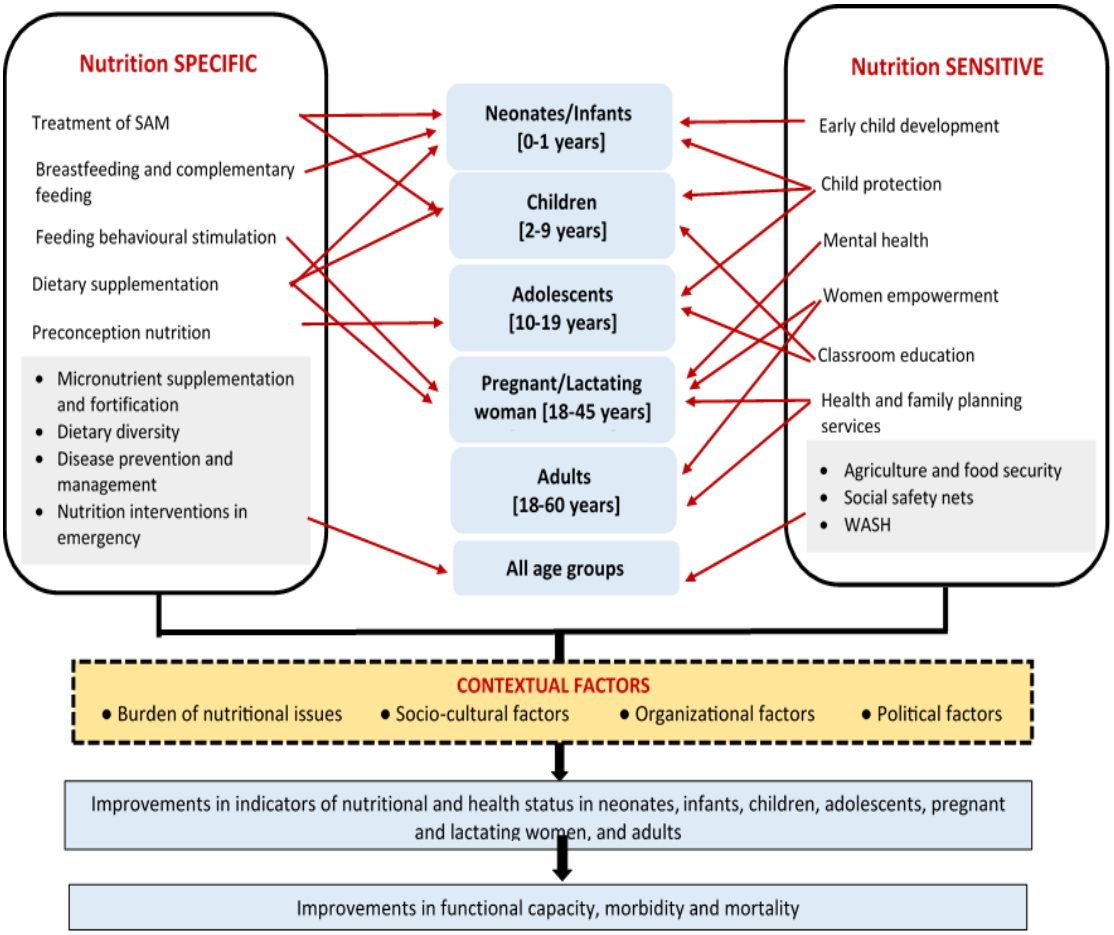
6 APPENDICES

APPENDIX I: CONCEPTUAL FRAMEWORK AS PER PROTOCOL



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APPENDIX III: INITIAL EXCLUSION CRITERIA

1. **Language**: are not published in English
2. **Date of publication**: not published between Jan 2000 to June 2016
3. **Types of SRs**: not a systematic review
4. **Population:** Participants with conditions like, Tuberculosis, HIV/AIDS, infectious diseases (malaria, hepatitis and typhoid), communicable diseases (diabetes, CVDs, chronic respiratory diseases, cancer).
5. **Interventions:** SRs which have not included at least one of the nutrition specific/sensitive interventions that aims to tackle issue of under-nutrition.

APPENDIX IV: LIST OF DATABASES

Databases (14)	Global (8) 1. Annual Reviews Biomedical 2. CINAHL 3. Global Health 4. IBSS 5. Medline 6. PsycINFO 7. PUBMED 8. Web of Science	Regional (6) 1. African Journals Online (AJOL) 2. Bangladesh Journals Online (BanglaJOL) 3. Indian Citation Index (ICI) 4. LILACS 5. Nepal Journals Online (NepJOL) 6. PakMediNet
SR Databases (6)	1. 3ie 2. Campbell Collaboration Library for SR 3. Cochrane Database of SRs 4. DFID 5. Joanna Briggs Institute 6. PROSPERO	
Digital Library (1)	Bioline International	

APPENDIX V: SEARCH TERMS

INTERVENTIONS [Initial search with intervention terms only]

Intervention* OR initiative* OR process* OR program* OR policy OR policies OR effect* OR "delivery mode" OR implication* OR scheme* OR strategy* OR outcome* OR impact OR evaluat* OR delivery OR implement*

AND

Nutrition* OR "maternal and child health" OR "maternal and child nutrition" OR "MNCH" OR "fortification" OR "single nutrient fortification" OR "folic acid supplementation" OR "iron supplementation" OR "multiple micronutrient powder" OR "early childhood development" OR "micronutrient supplementation" OR "micronutrient powders" OR "micronutrient sprinklers" OR "calcium supplementation" OR "iodine supplementation" OR "iodine fortification" OR "energy protein supplementation" OR "delayed cord clamping" OR "neonatal vitamin K administration" OR "neonatal vitamin A supplementation" OR "kangaroo mother care" OR "early initiation of breastfeeding" OR "promotion of breastfeeding" OR "responsive feeding" OR "promotion of dietary diversity" OR "complementary feeding" or "complementation" OR "vitamin A supplementation" OR "multiple micronutrient supplementation" OR "preventive zinc supplementation" OR "SAM" OR "facility based management" OR "community based management" OR "staple foods fortification" OR "home based fortification" OR "specific foods fortification" OR "cash transfer programs" OR "community based platforms" OR "nutrition education" OR "nutrition promotion" OR "IMNCI" OR "integrated management childhood illness" OR "school based programs" OR "LNS" OR "lipid based nutrient supplements" OR "ready-to-eat foods" OR "RUTF" OR "ready-to-eat therapeutic foods" OR "ready-to-eat supplementary foods" OR "RUSF" OR "vitamin D supplementation" OR " Omega-3 fatty acid supplementation" OR "nutrition sensitive" OR "home gardens" OR "home gardening" OR "kitchen garden" OR "vegetable garden" OR "household garden" OR "household gardening" OR "garden based nutrition program" OR "kitchen garden" OR "kitchen gardening" OR "project garden" OR "homestead plot" OR "homestead horticulture and gardening" OR "food garden" OR "food gardening" OR "home based food garden" OR "homestead food production" OR "homestead food production systems" OR "fortification" OR "bio-fortification" OR "social safety nets" OR "family allowance program" OR "child grant" OR "child support grant" OR "microfinance" OR "social transfer" OR "social assistance" OR "cash transfer" OR "conditional cash transfers" OR "monetary incentives" OR "unconditional transfers" OR "in-kind household food distribution" OR " transfer programs emergencies" OR "feeding" OR "school feeding" OR "meals" OR "snacks" OR "breakfast" OR "mid-day meal" OR "mid day meal" OR "feeding services" OR "lunch" OR "school feeding programs" OR "mot or development" OR "food security" OR "food supply" OR "food distribution" OR "food production" OR "food aid" OR "sustainable agriculture" OR "WASH" OR "water or sanitation and hygiene"

CONTEXT

"developing countries" OR "less developed countries" OR "underdeveloped" OR "underserved countries" OR "deprived countries" OR "poor countries" OR "third world countries" OR "transitional countries" OR "low income countries" OR "middle income countries" OR "lower middle income countries" OR "upper middle income countries" OR "low and middle income countries" OR "lesser developed countries" OR "developing nation" OR "developing economies" OR "LMICs" OR "LAMI countries" OR Africa* OR Asia* OR "Caribbean" OR "West Indies" OR "South America" OR "Latin America" OR

"Central America" OR "Sub-Saharan Africa" OR "underprivileged countries" OR "Afghanistan" OR "Albania" OR "Algeria" OR "American Samoa" OR "Angola" OR "Armenia" OR "Armenian" OR "Azerbaijan" OR "Bangladesh" OR "Belarus" OR "Byelarus" OR "Byelorussian" OR "Belorussian" OR "Belorussia" OR "Belize" OR "Benin" OR "Bhutan" OR "Bolivia" OR "Bosnia" OR "Herzegovina" OR "Hercegovina" OR "Botswana" OR "Brazil" OR "Bulgaria" OR "Burkina Faso" OR "Burkina Fasso" OR "Burundi" OR "Urundi" OR "Cabo Verde" OR "Cape Varde" OR "Cambodia" OR "Cameroon" OR "Cameroons" OR "Cameron" OR "Camerons" OR "Central African Republic" OR "Chad" OR "China" OR "Colombia" OR "Comoros" OR "Comoro Islands" OR "Com ores" OR "Congo" OR "Democratic Republic Congo" OR "Costa Rica" OR "Cote" OR "d'Ivoire" OR "Ivory Coast" OR "Cuba" OR "Djibouti" OR "Dominica" OR "Dominican Republic" OR "Ecuador" OR "Egypt" OR "United Arab Republic" OR "El Salvador" OR "Eritrea" OR "Ethiopia" OR "Fiji" OR "Gabon" OR "Gabonese Republic" OR "Gambia" OR "Georgia" OR "Georgia Republic" OR "Georgian Republic" OR "Ghana" OR "Grenada" OR "Guatemala" OR "Guinea" OR "Guinea-Bisau" OR "Guyana" OR "Haiti" OR "Honduras" OR "India" OR "Indonesia" OR "Iran" OR "Islamic Republic" OR "Iraq" OR "Jamaica" OR "Jordan" OR "Kazakhstan" OR "Kazakh" OR "Kenya" OR "Kiribati" OR "Korea" OR "Democratic People's Republic Korea" OR "Kosovo" OR "Kyrgyz Republic" OR "Kyrgyzstan" OR "Kirgizstan" OR "Kirghizia" OR "Krghiz" OR "Lao PDR" OR "Lebanon" OR "Lesotho" OR "Liberia" OR "Libya" OR "Macedonia" OR "Madagascar" OR "Malawi" OR "Malaysia" OR "Maldives" OR "Mali" OR "Marshall Islands" OR "Mauritania" OR "Mauritius" OR "Mexico" OR "Micronesia" OR "Federated States Micronesia" OR "Moldova" OR "Moldovia" OR "Mongolia" OR "Montenegro" OR "Morocco" OR "Mozambique" OR "Myanmar" OR "Myanmar" OR "Burma" OR "Namibia" OR "Nepal" OR "Nicaragua" OR "Niger" OR "Nigeria" OR "Pakistan" OR "Palau" OR "Panama" OR "Papua New Guinea" OR "Paraguay" OR "Peru" OR "Philippines" OR "Romania" OR "Rumania" OR "Roumania" OR "Rwanda" OR "Ruanda" OR "Samoa" OR "Sao Tome" OR "Principe" OR "Senegal" OR "Serbia" OR "Sierra Leone" OR "Solomon Islands" OR "Somalia" OR "South Africa" OR "South Sudan" OR "Sri Lanka" OR "Ceylon" OR "St. Lucia" OR "Saint Lucia" OR "St. Vincent" OR "Saint Vincent" OR "Grenadines" OR Sudan* OR Surinam* OR "Swaziland" OR "Syrian Arab Republic" OR "Syria" OR "Tajikistan" OR "Tadzhikistan" OR "Tadjikistan" OR "Tadzhik" OR "Tanzania" OR "Thailand" OR "Timor-Leste" OR "Timor Leste" OR "Togo" OR "Tonga" OR "Tunisia" OR "Turkey" OR "Turkmenistan" OR "Tuvalu" OR "Uganda" OR "Ukraine" OR "Uzbekistan" OR "Uzkek" OR "Vanuatu" OR "Vietnam" OR "Viet Nam" OR "West Bank" OR "Gaza" OR "Yemen" OR "Zambia" OR "Zimbabwe"
STUDY DESIGN "systematic review" OR "SLR" OR meta-analysis* OR meta-review* OR meta-regression* OR meta-synthesis* OR "realistic review" OR "descriptive review" OR "research review" OR "thematic review" OR "explanatory review" OR "narrative review" OR "integrative review" OR "mixed method review" OR "qualitative review" OR "quantitative review" OR "research synthesis" OR "evaluation review" OR "evidence mapping" OR "evidence map review" OR "impact review"

APPENDIX VI: SEARCH STRATEGY

#	Databases	Search Strategy	No. of hits
1	Annual Reviews Biomedical	Search Query: [All fields: nutrition*] AND [[All fields: “breastfeeding”] OR [All fields: “complementary]] AND[[All fields: feeding”] OR [All fields: “micronutrient”] OR [All fields: “staple]] AND [[All fields: food”] OR [All fields: “specific]] AND [[All fields: food”] OR [All fields: “dietary]] AND [[All fields: diversity”] OR [All fields: educat*] OR [All fields: promot*] OR [All fields: fortif*] OR [All fields: supplement*] OR [All fields: “food]] AND[[All fields: security”] OR [All fields: “food]] AND [[All fields: distribution”] OR [All fields: “food]] AND [[All fields: supply”] OR [All fields: “food]] AND [[All fields: production”] OR [All fields: “kitchen]] AND [[All fields: garden”]OR [All fields: “meal”] OR [All fields: “social]] AND [[All fields: safety”] OR [All fields: “cash]] AND [[All fields: transfer”] OR [All fields: “sanitation”] OR [All fields: “hygiene”]] AND [Publication Date: (01/01/2000 TO12/31/2016)]	70
2	African Journals Online (AJOL)	Intervention* OR initiative* OR process* OR program* OR policy OR policies OR effect* OR "delivery mode" OR implication* OR scheme* OR strategy* OR outcome* OR impact OR evaluat* OR delivery OR implement* OR campaign OR AND Nutrition* (review) [filters: within journals-all, from 01 jan 2004 until 30 june 2016]	16
3	Bangladesh Journals Online (BanglaJOL)	((Intervention* OR initiative* OR process* OR program* OR polic* OR effect* OR "delivery mode" OR implication* OR scheme* OR strateg* OR outcome* OR impact OR evaluat* OR delivery OR implement* OR campaign) AND Nutrition* AND Review*) [filters: within journals-all, from 01 jan 2007 until 30 june 2016]	35
4	Indian Citation Index (ICI)	Title=(Nutrition* OR “Breastfeeding” OR “complementary feeding” OR “micronutrient” OR “staple food” OR “specific food” OR “dietary diversity” OR fortif* OR supplement* OR “food security” OR “food distribution” OR “food supply” OR “food production”) And City/State/Country=(India) And Document type=(REVIEW ARTICLE) AND Refined By: Subject= (HEALTH SCIENCE OR BIOLOGICAL SCIENCE OR GENERAL SCIENCE AND TECHNOLOGY OR SOCIAL SCIENCE) AND Refined By: Source= (INDIAN JOURNAL OF MEDICAL RESEARCH OR INDIAN PEDIATRICS OR ECONOMIC AND POLITICAL WEEKLY OR ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH OR INDIAN JOURNAL OF CLINICAL PRACTICE OR INDIAN JOURNAL OF NUTRITION AND DIETETICS OR INDIAN JOURNAL OF ENDOCRINOLOGY AND METABOLISM OR JOURNAL INDIAN ACADEMY OF CLINICAL MEDICINE OR NATIONAL MEDICAL JOURNAL OF INDIA) Timespan=All Years Document type: Review Article Time span: 2004-2016 Country: India	India- 35

5	LILACS	(tw:(nutrition*)) AND (tw:(“breastfeeding” OR “complementary feeding” OR “micronutrient” OR “staple food” OR “specific food” OR “dietary diversity” OR educat* OR promot* OR fortif* OR supplement* OR “food security” OR “food distribution” OR “food supply” OR “food production” OR “kitchen garden” OR “meal” OR “social safety” OR “cash transfer” OR “sanitation” OR “hygiene”)) AND (instance:"regional") AND (type_of_study:("systematic_reviews") AND la:("en"))	398
6	Nepal Journals Online (NepJOL)	((Intervention* OR initiative* OR process* OR program* OR polic* OR effect* OR "delivery mode" OR implication* OR scheme* OR strateg* OR outcome* OR impact OR evaluat* OR delivery OR implement* OR campaign) AND Nutrition* AND Review*) [filters: within journals-all, from 01 jan 2006 until 30 june 2016]	52
7	PakMediNet	Nutrition Review	21
8	3ie	Intervention* OR initiative* OR process* OR program* OR policy OR policies OR effect* OR "delivery mode" OR implication* OR scheme* OR strategy* OR outcome* OR impact OR evaluat* OR delivery OR implement* OR campaign AND Nutrition* [filter used: Sectors-Health, Nutrition and population; multisector, water and sanitation, Region-South Asia, Sub-Sharan Africa, Latin America and the Caribbean, all LMICs , Population-All, Status-review, Type-effectiveness, Date-2000 to 2016]	28
9	Campbell Collaboration Library for SR	Intervention* OR initiative* OR process* OR program* OR policy OR policies OR effect* OR "delivery mode" OR implication* OR scheme* OR strategy* OR outcome* OR impact OR evaluat* OR delivery OR implement* OR campaign (all text) AND Nutrition* (all text) [filter used: coordinating groups-nutrition, type of document-review, publication year- 2003 to 2016]	2
10	Cochrane Database of SRs	Covered under Cochrane Library	
11	DFID	Intervention* OR initiative* OR process* OR program* OR policy OR policies OR effect* OR "delivery mode" OR implication* OR scheme* OR strategy* OR outcome* OR impact OR evaluat* OR delivery OR implement* OR campaign (document summary) AND Nutrition* (document summary) [filter used: document type-systematic review]	4
12	Joanna Briggs Institute	Keywords- Nutrition (All fields) Content types- Articles Publication dates- All Dates	260
13	PROSPERO	Search for: Nutrition Following filters were selected Restrict search to specific fields- Intervention Date added to PROSPERO 01/01/2000 TO 30/06/2016 Type of Protocol: Exclude Cochrane Status of the review: Published	9
14	Bioline International	Nutrition Review	45

APPENDIX VII: DETAILED INCLUSION CRITERIA

Language: Published in English

Date of publication: Jan 2000 to June 2016, in order to be completed within the limited time boundary of the project.

Types of SRs:

3.1. Searched at least two electronic databases and included a method describing how the studies were included and/or excluded

3.2. Synthesised primary evidence on the effectiveness of nutrition programs in LMICs and draw conclusions based on findings from individual studies irrespective of the study designs of the included primary studies

Population: Include the general population with a specific focus on vulnerable groups such as children, women and other socio-economically disadvantaged groups.

Interventions: SRs which have included at least one of these interventions that aim to tackle issue of under-nutrition by improving dietary intake of beneficiaries including-

Nutrition Specific and Sensitive interventions

WHO, WFA, & UNICEF. (2007). Preventing and controlling micronutrient deficiencies in populations affected by an emergency. *World Health Organization*. Retrieved from http://www.who.int/nutrition/publications/WHO_WFP_UNICEFstatement.pdf

Nutrition specific	● Folic acid supplementation ● Iron supplementation ● Iron and folic acid supplementation ● Multiple micronutrient supplementation ● Calcium supplementation ● Iodine supplementation ● Iodine fortification ● Energy and protein supplementation ● Delayed cord clamping ● Neonatal vitamin K administration ● Neonatal vitamin A supplementation ● Kangaroo mother care ● Promotion of breast feeding and supportive strategies ● Promotion of dietary diversity and complementary feeding ● Vitamin A supplementation in children ● Iron supplementation for infants and children ● Multiple micronutrient supplementation in children ● Preventive zinc supplementation in children ● Prevention and treatment of SAM- facility based & community based management ● Fortification of staple foods and specific foods ● Community based platforms for nutrition education and promotion ● Integrated management of childhood illness ● School based delivery platforms

	● Child health days ● Nutrition interventions in humanitarian emergency settings ● Lipid based nutrient supplements ● Maternal vitamin D supplementation ● Omega-3 fatty acid supplementation in pregnancy
Nutrition sensitive	● Agriculture ● Home gardens and homestead food production systems ● Bio-Fortification ● Social safety nets ● Conditional cash transfers ● Unconditional transfers ● School feeding programs ● In- kind household food distribution ● Transfer programs in emergencies ● Early child development ● Food security ● Water, sanitation and hygiene

Comparators: Will include all SRs irrespective of they had a comparison group or not.

Outcomes: SRs which have included at least one of these outcomes that reflect

7.1 Primary outcomes

- Reduction in nutritional issues such as wasting, stunting, underweight, chronic energy deficiency, micronutrient deficiencies (anaemia, zinc, iodine, iron, vitamin A, vitamin B12, folic acid) and improvement in adequate dietary intakes of nutrients

7.2 Secondary outcomes

- Improvements in functional capacity: cognition, capacity to work, work efficiency
- Morbidity: Reduction in disease burden- overweight, obesity, diarrheal diseases, respiratory tract diseases
- Mortality

Context: Population from LMICs, these will be classified according to the World Bank definition (World Bank, 2016)

APPENDIX VIII: CRITICAL APPRAISAL TOOL

Reviewer Name		Study Code		Total Score	
1	Was an 'a priori' design provided? *The research question and inclusion criteria should be established before the conduct of the review.*			□ Yes □ No □ Can't answer □ Not applicable	
2	Was there duplicate study selection and data extraction? *There should be at least two independent data extractors and a consensus procedure for disagreements should be in place.*			□ Yes □ No □ Can't answer □ Not applicable	
3	Was a comprehensive literature search performed? *At least 2 electronic sources should be searched. The report must include years and databases used (e.g., Central, EMBASE, and MEDLINE). Key words and/or MESH terms must be stated and where feasible the search strategy should be provided. All searches should be supplemented by consulting current contents, reviews, textbooks, specialized registers, or experts in the particular field of study, and by reviewing the references in the studies found.*			□ Yes □ No □ Can't answer □ Not applicable	
4	Was the status of publication (i.e. grey literature) used as an inclusion criterion? *The authors should state that they searched for reports regardless of their publication type. The authors should state whether or not they excluded any reports (from the systematic review), based on their publication status, language etc.*			□ Yes □ No □ Can't answer □ Not applicable	
5	Was a list of studies (included and excluded) provided? *A list of included and excluded studies should be provided.*			□ Yes □ No □ Can't answer □ Not applicable	
6	Were the characteristics of the included studies provided? *In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. The ranges of characteristics in all the studies analyzed e.g., age, race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.*			□ Yes □ No □ Can't answer □ Not applicable	

7	Was the scientific quality of the included studies assessed and documented? *'A priori' methods of assessment should be provided (e.g., for effectiveness studies if the author(s) chose to include only randomized, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.*	□ Yes □ No □ Can't answer □ Not applicable	
8	Was the scientific quality of the included studies used appropriately in formulating conclusions? *The results of the methodological rigor and scientific quality should be considered in the analysis and the conclusions of the review, and explicitly stated in formulating recommendations.*	□ Yes □ No □ Can't answer □ Not applicable	
9	Were the methods used to combine the findings of studies appropriate? *For the pooled results, a test should be done to ensure the studies were combinable, to assess their homogeneity (i.e., Chi-squared test for homogeneity, I2). If heterogeneity exists a random effects model should be used and/or the clinical appropriateness of combining should be taken into consideration (i.e., is it sensible to combine?).*	□ Yes □ No □ Can't answer □ Not applicable	
10	Was the likelihood of publication bias assessed? *An assessment of publication bias should include a combination of graphical aids (e.g., funnel plot, other available tests) and/or statistical tests (e.g., Egger regression test, Hedges-Olken).*	□ Yes □ No □ Can't answer □ Not applicable	
11	Was the conflict of interest included? *Potential sources of support should be clearly acknowledged in both the systematic review and the included studies.*	□ Yes □ No □ Can't answer □ Not applicable	

APPENDIX IX: DATA EXTRACTION TOOL

General Information		
1.	What is the Review ID	☐ Internal ID
2.	Who is the first author	☐ Enter Author name
3.	What is the publication year	☐ Enter year
4.	What is the publication type	☐ Journal article ☐ Report ☐ Cochrane Review ☐ Other (specify)
5.	Do authors report explicitly how the review was funded	☐ Yes ☐ Unclear
6.	Conflict of interest declared	☐ Yes ☐ No
7.	Potential conflict of interest from funding	☐ Yes ☐ No ☐ Unclear
Context		
1.	What is the context (based on World Bank income classification)	☐ Explicitly stated ☐ LMICs ☐ Both ☐ Not stated
2.	Identify the source countries mentioned in the included studies	☐ Explicitly stated ☐ Yes ☐ No If yes, ☐ Name of country/countries (add names in info) ☐ Whether any of the 6 south Asian countries were included ☐ Yes ☐ Afghanistan ☐ Bangladesh ☐ India ☐ Myanmar ☐ Nepal ☐ Pakistan ☐ No
Participants		
1.	What type of participants were included	☐ Women ☐ Pregnant women ☐ Lactating women ☐ Other women (Specify) ☐ Infants

		☐ Children ☐ Preschool children/toddlers ☐ School children ☐ Children with specific health conditions ☐ Other children (Specify) ☐ Adolescents ☐ Adults ☐ Elderly ☐ Other (Specify)
2.	What is the number of participants considered for analysis in the review	☐ Explicitly stated ☐ Yes ☐ No ☐ Number: ☐ Implicit ☐ Yes ☐ No ☐ Number: ☐ Not stated/ unclear
3.	What are the participant socio-demographic characteristics	☐ Age: Explicitly stated ☐ Yes ☐ No ☐ Age range: (Specify) ☐ 0-2 years ☐ 2-5 years ☐ 6-9 years ☐ 10 – 19 years ☐ 20 - 45 years ☐ 46 – 59 years ☐ 60 years and above ☐ Gender ☐ Male ☐ Female ☐ Not stated ☐ Geographic location ☐ Rural ☐ Tribal ☐ Urban ☐ Mixed ☐ Not stated ☐ Socio economic status ☐ Low income ☐ Middle income

		☐ High income ☐ Not stated
Review Characteristics		
1.	What is the review type	☐ Narrative review ☐ Meta - analysis ☐ Other (specify)
2.	Was the review explicitly informed by, or linked to, an existing body of empirical and/or theoretical framework	☐ Yes ☐ No ☐ Not clear
3.	What is the purpose /aim of the review	☐ Description ☐ Exploration of effectiveness ☐ What works? ☐ Any other
4.	How many databases were searched for the review	☐ 2 ☐ 3 – 4 ☐ 5-6 ☐ 7 or more
5.	Was grey literature included	☐ Yes ☐ No
6.	What was the review design	☐ Quantitative ☐ Mixed
7.	Mention the type of included studies	☐ RCTs only ☐ RCTs + other types of studies ☐ Studies other than RCTs ☐
8.	Is the inclusion and exclusion criteria stated	☐ Yes ☐ No
9.	How many studies were included	☐ <10 ☐ 10-19 ☐ 20-29 ☐ >30
10.	What was the Amstar score	☐ High 8-11 ☐ Medium 4-7 ☐ Low 0-3

11.	What are the final conclusions drawn by the authors regarding evidence	☐ Adequacy of evidence ☐ Continue with existing policy ☐ Modifications in the existing policies ☐ Need for new policy ☐ More research required ☐ Not enough evidence
12.	Was the SR conducted/funded by international agencies	☐ WHO ☐ UNICEF ☐ ICCIDD ☐ MI ☐ USAID ☐ DFID ☐ Other (specify)
Interventions		
1.	Total how many nutrition intervention(s) was/were assessed?	☐ Number -
2.	What type of nutrition intervention(s) was/were assessed?	☐ Nutrition Specific ☐ Nutrition Sensitive ☐ Both
3.	If, Nutrition specific	☐ Total number of intervention(s) ☐ Enter number in info ☐ Mention number of specific intervention in info-
4.	Name of specific intervention(s) ☐ Energy and protein* ☐ Micronutrients ☐ Calcium* ☐ Folic acid* ☐ Iodine* ☐ Iron* ☐ Magnesium* ☐ Multiple micronutrient* ☐ Vitamin A* ☐ Vitamin C* ☐ Vitamin D* ☐ Vitamin E* ☐ Zinc* ☐ Omega-3 fatty acid/ N-3 fatty acid/ PUFA/long chain poly-unsaturated fatty acids* ☐ Delayed cord clamping* ☐ Kangaroo mother care*	☐ To whom the intervention was given? ☐ What dose/level of intervention was given? ☐ Till how long the intervention was given? [days/weeks/months/ etc.] ☐ Where was the intervention given? [Home/Health facility/school etc.] ☐ Through which medium the intervention was delivered? [Fortification/supplementation]

	□ Severe acute malnutrition- facility based and community based management (RUTF/Lipid based nutrient)* □ Promotion of breast feeding and supportive strategies* □ Promotion of dietary diversity and complementary feeding* □ School feeding programs* □ Nutrition education and promotion* *[All the questions were same for all nutrition specific interventions]	
5.	If , Nutrition sensitive	□ Total number of intervention(s) □ Number □ Mention number of sensitive intervention in info-
6.	Name of sensitive intervention(s) □ Agriculture* □ Home gardens and homestead food production systems (access to foods)* □ Household food distribution* □ Social safety nets* □ Cash transfers* □ Water, Sanitation and Hygiene* *[All the questions were same for all nutrition sensitive interventions]	□ To whom the intervention was given? □ What dose/level of intervention was given? □ Till how long the intervention was given [days/weeks/months/ etc.] □ Where was the intervention given? [Home/Health facility/school etc.] □ Through which medium the intervention was delivered? [Fortification/supplementation]
7.	Both (specific and sensitive)	□ Yes □ Total number of specific and sensitive both interventions □ Mention number here in info
8.	Nutrition Programmes (including both interventions)	□ Name of nutrition programme/s □ Name of interventions under this programme □ To whom the interventions were given? □ What dose/level of interventions were given? □ Till how long the interventions were given? [days/weeks/months/ etc.] □ Where was the intervention given? [Home/ health facility/school etc.]

		☐ Through which medium the interventions were delivered? [Fortification/supplementation]
WHA Targets		
1.	Whether WHA nutrition targets (outcomes) assessed in SR?	☐ Yes ☐ No
2.	If yes, which WHA nutrition target was majorly focused?	☐ Stunting among <5 children ☐ Anaemia among women ☐ Low birthweight ☐ Breastfeeding ☐ Wasting
Outcomes		
1.	Total how many outcomes were assessed in present SR?	☐ Number -
Primary outcome		
2.	Nutritional status ☐ Weight for age* ☐ Height/length for age* ☐ Weight for height/length* ☐ Mean body mass index-BMI* ☐ Underweight as per BMI* ☐ Obesity as per BMI* ☐ Overweight as per BMI* ☐ Weight gain* ☐ Height/length gain* ☐ Head circumference /growth* *[All the questions were same for all nutritional status outcomes]	☐ No. of studies in SR specific to this outcome underweight ☐ No. of studies in SR specific to this outcome from LMICs ☐ No. of participants included in analysis of this outcome ☐ Category of participants included in analysis of this outcome ☐ Whether meta-analysis was performed? ☐ Yes ☐ No If yes, ☐ Mention effect measures/size ☐ Whether heterogeneity was identified? ☐ Risk of bias of studies done? ☐ Whether sub-group analysis was done? ☐ Yes ☐ No If yes, ☐ Define based on population ☐ Define based on intervention ☐ Define based on outcomes If no, ☐ Mention narrative summary ☐ Whether quality of included studies was assessed? [Define the tool used]
3.	Micronutrient deficiencies ☐ Deficiency of calcium* ☐ Deficiency of folic acid*	☐ No. of studies in SR specific to this outcome underweight

	□ Deficiency of iodine* □ Deficiency of iron* □ Deficiency of magnesium* □ Deficiency of multiple micronutrient* □ Deficiency of vitamin A* □ Deficiency of vitamin C* □ Deficiency of vitamin D* □ Deficiency of vitamin E* *[All the questions were same for all micronutrient deficiency outcomes]	□ No. of studies in SR specific to this outcome from LMICs □ No. of participants included in analysis of this outcome □ Category of participants included in analysis of this outcome □ Whether meta-analysis was performed? □ Yes □ No If yes, □ Mention effect measures/size □ Whether heterogeneity was identified? □ Risk of bias of studies done? □ Whether sub-group analysis was done? □ Yes □ No If yes, □ Define based on population □ Define based on intervention □ Define based on outcomes If no, □ Mention narrative summary □ Whether quality of included studies was assessed? [Define the tool used]
4.	Dietary intakes of nutrients/foods □ Energy and protein* □ Fruits and vegetables* *[All the questions were same for dietary intakes of nutrients/foods outcome]	□ No. of studies in SR specific to this outcome underweight □ No. of studies in SR specific to this outcome from LMICs □ No. of participants included in analysis of this outcome □ Category of participants included in analysis of this outcome □ Whether meta-analysis was performed? □ Yes □ No If yes, □ Mention effect measures/size □ Whether heterogeneity was identified? □ Risk of bias of studies done? □ Whether sub-group analysis was done? □ Yes □ No If yes, □ Define based on population

		☐ Define based on intervention ☐ Define based on outcomes If no, ☐ Mention narrative summary ☐ Whether quality of included studies was assessed? [Define the tool used]
Secondary outcome		
1.	☐ Capacity to work ☐ Work efficiency ☐ Learning abilities ☐ Cognition ☐ Motor development ☐ Mental development ☐ Diarrheal diseases ☐ Acute respiratory diseases ☐ Infections ☐ Blood pressure/hypertension ☐ Neonatal mortality ☐ Infant mortality ☐ Under 5 children mortality ☐ Maternal mortality ☐ Measles mortality ☐ Pneumonia mortality ☐ Malaria mortality ☐ Other causes mortality ☐ Diarrheal mortality *[All the questions were same for secondary outcome]	☐ No. of studies in SR specific to this outcome underweight ☐ No. of studies in SR specific to this outcome from LMICs ☐ No. of participants included in analysis of this outcome ☐ Category of participants included in analysis of this outcome ☐ Whether meta-analysis was performed? ☐ Yes ☐ No If yes, ☐ Mention effect measures/size ☐ Whether heterogeneity was identified? ☐ Risk of bias of studies done? ☐ Whether sub-group analysis was done? ☐ Yes ☐ No If yes, ☐ Define based on population ☐ Define based on intervention ☐ Define based on outcomes If no, ☐ Mention narrative summary ☐ Whether quality of included studies was assessed? [Define the tool used]
Other outcomes		
1.	☐ Access to services ☐ Child labour ☐ Miscarriage ☐ Pre-eclampsia ☐ Fetal growth ☐ IUGR ☐ LBW ☐ Birth length	☐ No. of studies in SR specific to this outcome underweight ☐ No. of studies in SR specific to this outcome from LMICs ☐ No. of participants included in analysis of this outcome ☐ Category of participants included in analysis of this outcome

	☐ Birthweight ☐ Pre-term birth ☐ SGA ☐ Stillbirth ☐ Breastfeeding ☐ Pnemonia prevalence ☐ Haemoglobin concentration *[All the questions were same for other outcome]	☐ Whether meta-analysis was performed? ☐ Yes ☐ No If yes, ☐ Mention effect measures/size ☐ Whether heterogeneity was identified? ☐ Risk of bias of studies done? ☐ Whether sub-group analysis was done? ☐ Yes ☐ No If yes, ☐ Define based on population ☐ Define based on intervention ☐ Define based on outcomes If no, ☐ Mention narrative summary ☐ Whether quality of included studies was assessed? [Define the tool used]

Abbreviations

BMGF	Bill and Melinda Gates Foundation
BMI	Body Mass Index
BRAC	Bangladesh Rehabilitation Assistance Committee
CINI	Child in Need Institute
CF	Complementary feeding
DFID	The Department for International Development
EBF	Exclusive Breastfeeding
FANTA	Food and Nutrition Technical Assistance Project
FAO	Food and Agriculture Organization of the United Nations
FHI360	Family Health International
FNB	Food and Nutrition Bulletin
GAIN	Global Alliance for Improved Nutrition
GNR	Global Nutrition Report
HIC	High Income Countries
HZA	Height for Age Z scores (Stunting)
ICCIDD	International Council for Control of Iodine Deficiency Disorders
IDA	Iron Deficiency Anaemia
IDS	Institute of Development Studies
IFA	Iron-Folic Acid
IFPRI	International Food Policy Research Institute
LANSA	Leveraging Agriculture for Nutrition in South Asia
LMICs	Low and Middle Income Countries
LC-PUFA	Long chain poly-unsaturated fatty acids
MDGs	Millennium Development Goals
MI	Micronutrient Initiative
MMN	Multiple Micronutrient
MoH	Ministry of Health
NCHS	National Center for Health Statistics
OFSP	Orange-flesh sweet potato
OTS	Other Type of Studies
RUTF	Ready to Eat Therapeutic Foods
SAM	Severe Acute Malnutrition
SARH	South Asia Research Hub
SDGs	Sustainable Development Goals
SPRING	The Strengthening Partnerships Results and Innovations in Nutrition Globally Project
SR	Systematic Review
SUN	Scaling Up Nutrition
THR	Take Home Rations
TN	Transform Nutrition
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
WFP	World Food Programme

WHA	World Health Assembly
WHO	World Health Organization
WHZ	Weight for Height Z scores (Wasting)
WASH	Water and Sanitation Hygiene

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