Review Article

Best buys for treatment of severe and moderate acute malnutrition in South Asian Association for Regional Cooperation Countries: A systematic review and meta-analysis

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ABSTRACT

Background: South Asian Association for Regional Cooperation (SAARC) Countries, consisting of low-income and low- and middle-income countries in Indian Subcontinent have high burden of malnutrition among children under 5 years of age. Multiple studies have been conducted to test various interventions for improving the nutrition status of children under 5 years of age. However, limited work is done on identifying what are the best practices that emerged through various studies, which can be scaled up or can be integrated with national programs. **Objective:** The objective of this study is to systematically identify best practices compared against standard care. **Materials and Methods:** A systematic literature search was carried from online databases including: Medline, Embase, Jstor, J-gate, Ovid, and Cochrane Library. The search was limited to English language, studies carried out in SAARC countries and limited to studies carried out over past 10 years. Search strategy yielded 2884 results, after screening through title for language, geography, and duration. Eleven studies were included for meta-analysis. Studies were classified into four categories of special nutrition programme (SNP) to children interventions, IEC interventions, Maternal SNP interventions, and Micronutrient interventions. Data on outcome were measured as per the World Health Organization standards for Z score for Stunting, Wasting, and Underweight. Data were abstracted and entered into RevMan 5.3 for meta-analysis. Study quality was analyzed using Child Health Epidemiology Reference Group adaptation of the GRADE checklist. Inverse variance using random effects models was drawn for pooled effects along with test with heterogeneity. **Results:** For SNP to Children interventions, overall effect for underweight marginally favors commercially available or internationally produced SNPs over locally produced SNPs with mean difference of 0.08, (95% confidence interval [CI] 0.04, 0.11), $I^2 = 12\%$. Overall effects for wasting were marginally favoring International SNP over local SNP with mean difference of 0.08, (95% CI 0.04, 0.12), $I^2 = 31\%$. For Maternal SNPs, overall effect for underweight inclines for Standard Maternal Care over Maternal SNP with mean difference of 0.14, (95% CI 0.07, 0.21), $I^2 = 0\%$. Overall effect for stunting inclines for Standard Maternal Care over Maternal SNP with mean difference of 0.10, (95% CI 0.05, 0.14), I2 = 0%. IEC interventions presented inconclusive results. Micronutrient interventions had heterogenous data. **Conclusion:** From our study, the identification of best practices did not provide evidence to back any specific intervention over standard practice. The standard care offered through Integrated Child Development Programme provides all-inclusive coverage in management of malnutrition among children under 5 years of age.

KEY WORDS: Treatment of Malnutrition; Special Nutrition Products; Micronutrients

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INTRODUCTION

Malnutrition among children is leading global problem, The World Health Organization (WHO) estimates 47 million children under 5 years of age are wasted, 14.3 million are severely wasted and 144 million are stunted; around 45% of deaths among

children under 5 years of age are linked to undernutrition.[1] The burden of malnutrition among children under 5 years is higher in low- and middle-income countries.[1] The South Asian Association for Regional Cooperation (SAARC) is association of eight countries Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka located in the Indian Subcontinent. The SAARC countries are low- to low-and middle-income countries, with prevalence of stunting ranging from 40% to 60% across various countries, and prevalence of wasting ranging from 15% to 30% across various countries.[2] India which accounts for a major population in the SAARC region accounts for malnutrition being the predominant risk factor for death in children under 5 years of age, accounting for 68.2% (95% UI 65·8–70·7) of the total under-5 deaths for the year 2017 and the leading risk factor for health loss for all ages, responsible for 17·3% (16·3–18·2) of the total disability-adjusted life years.[3]

Prevention and management of malnutrition require multisectoral interventions consisting of Micronutrient Specific Interventions, Public Health Interventions, and Non-Micronutrient Specific Intervention.[4] The Micronutrient interventions consist of interventions such as supplementary food programs, iron, and folic acid supplements. The Public Health Intervention consists of interventions such as water, sanitation, and hygiene (WASH) programs, Information Education and Communication interventions. Non-Micronutrient specific interventions include agriculture produce improvement, cash transfer.[4]

Integrated Child Development Services (ICDS) program is one of the largest community based program in India targeting pregnant women, lactating mothers, children below 6 years of age, adolescent girls with objective to improve health, nutrition, and education of targeted groups and reduce the burden malnutrition.[5] Various interventions have been implemented across the globe individually or in combination to reduce the burden of malnutrition. SAARC countries have adopted national level and state level programs to combat malnutrition; however, a comprehensive and systematic analysis of interventions specific to SAARC countries was not undertaken to the best of our knowledge.

We undertook systematic review and meta-analysis of randomized controlled trials conducted in SAARC region for the management of severe to mild acute malnutrition.

Objectives

The objective of this study is to identify best practices for management of severe to mild malnutrition in SAARC countries.

Secondary Objective is to identify best intervention under:
a. Special Nutrition Programme
b. Information Education and Communication
c. Maternal Special Nutrition Programme
d. Micronutrient Programme

MATERIALS AND METHODS

Search Methodology

We developed a comprehensive search strategy for online database including: Medline, Embase, Jstor, J-gate, Ovid, and Cochrane Library**.** Other literature sources were Google Scholar, and Research Gate. Studies from 2010 to 2020 were included in the study [Figure 1]. Search was limited to English Language. The key word used for building the search strategy include Malnutrition, Undernutrition, Wasting, Stunting, Underweight, Children, Infants, Young Children, Age 0–5 years, Under 5 years, ICDS, WASH, Micronutrients, Water and Sanitation, India, Bangladesh, Nepal, Pakistan, and Sri Lanka. Appropriate Boolean operators such as "OR," "AND" were used [Annexure A]. The search was carried from March 2020 to August 2020. The protocol was registered with PROSPERO International prospective register of systematic reviews vide registration number CRD42020178487. A study protocol was reviewed by the Ethics Committee of Public Affairs Centre.

We used the WHO classification based on Z scores to classify stunting, wasting, and underweight,

Stunting was defined as −1 Z Score for Height for Age (HAZ) for mild stunting, −2 HAZ for moderate stunting, and −3 HAZ for severe stunting. Wasting was defined as −1 Z score for weight for age (WAZ) for mild wasting, −2 WAZ for moderate stunting, and −3 WAZ for severe wasting. Underweight was defined as −1 Z score for weight for height (WHZ) for mild underweight, −2WHZ for moderate underweight, and −3 WHZ for sever underweight.

Inclusion Criteria

The following criteria were included in the study:
- Randomized Controlled Trials included children aged 0–5 years diagnosed with mild to severe stunting, wasting and underweight.
- Studies on residents of SAARC Countries (Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka).
- Studies on Intervention designed to be applied in Home or Community Settings.

Exclusion Criteria

The following criteria were excluded from the study:
- Studies on residents outside SAARC Countries.
- Studies conducted (Data collection) before December 2009.
- Studies on intervention designed for hospitalization.

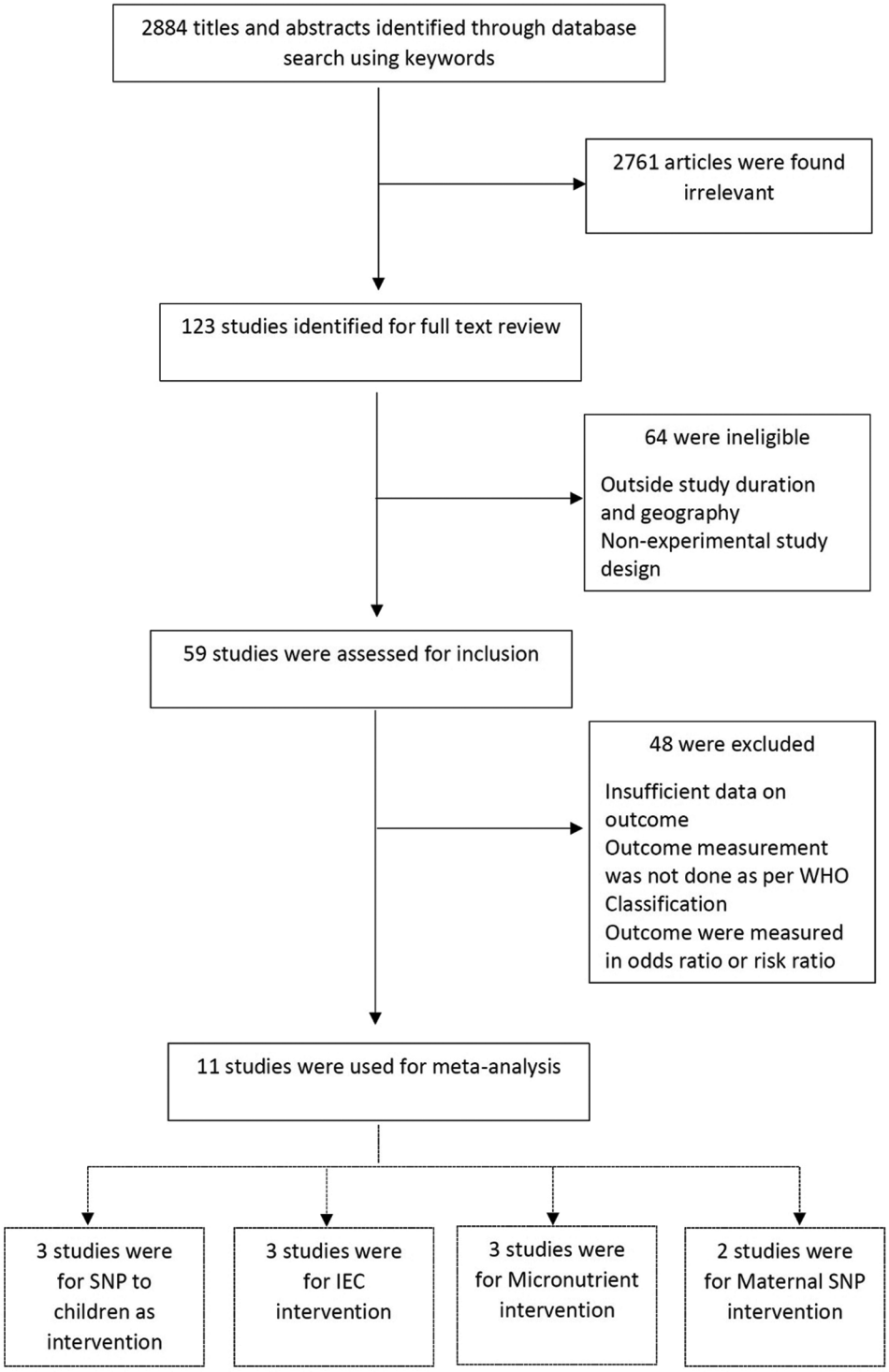

Figure 1: Study schematics

- Studies using non-experimental designs (Cohort, Cross-Sectional, and Case–Control).

The main outcome of this study was change in malnutrition status from Severe (−3SD) to Moderate (−2SD) to Mild (−1SD) Z score as defined by 2006 WHO growth standards. Outcomes were measured in mean change in Z score across experimental and control groups.

Data Synthesis and Quality Assessment

We coded and categorized the interventions used in each of the article. Meta-analysis was conducted for Supplementary Nutritional Products interventions, IEC interventions, and Micronutrient interventions. The control groups for all the three categories include standard treatment options. Studies with multiple interventions were analyzed for each arm against control. We used Review Manager (RevMan) Version

5.3, The Cochrane Collaboration, 2014; to abstract and collect information about the study characteristics, descriptions of interventions and comparisons, and outcome of interest and effects. We assessed quality based on the Child Health Epidemiology Reference Group adaptation of the GRADE checklist at individual study level.[6,7] We applied generic inverse variance methods to analyses and used random effects models. Summary estimates were presented as standard means differences with 95% confidence intervals (CI).

RESULTS

Using the above-mentioned search strategy yielded 2884 results, after screening through title for language, geography, and duration of study the number of searches came down to 123. Authors AP and SS screened through abstracts independently of the 123 studies and screened for randomized controlled trails study design and study settings. Any conflicts arising were referred to author DB. Fifty-nine studies were assessed for outcomes, measures of effect. Eleven studies were included for meta-analysis. Figure 1 presents the study schematics.

A meta-analysis was carried out on group of studies based on the intervention types. Supplementary Nutritional Products for Children had three studies, with eight interventions. IEC interventions had three studies with four interventions. Maternal single nucleotide polymorphisms (SNP) intervention had three studies with ten interventions. Micronutrient intervention had three studies with four interventions. The details about the studies included in the meta-analysis are given in Table 1.

Quality Assessment

The quality assessment was conducted separately by both authors AP and SS. The authors assessment was merged for coinciding results, any conflicts arisen were resolved with help of author AP. Figure 2 presents the quality assessment of the studies for selection bias, performance bias, detection bias, and attrition bias. Choudhary *et al*.[8] had high risk for random sequence generation as author has not specifically mentioned in the paper about random sequence generation and sequence allocation. Attrition bias due to unequal loss to follow-up was seen in Choudhary *et al*.,[8] Gope *et al*.,[9] Khan *et al*., and [10] Mridha *et al*.[11]

For all the studies included in the review, the combined risk of bias is presented at Figure 3. For the studies included in the review, risk of attrition bias due to loss to follow-ups was highest.

Special Nutrition Products for Children, Locally Manufactured versus Internationally Manufactured

Three articles presenting eight special nutrition product interventions were compared to standard care for stunting

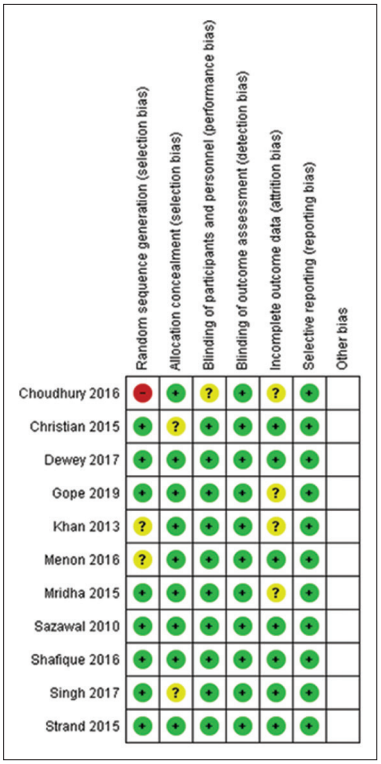

Figure 2: Risk of bias summary: review authors' judgments about each risk of bias item for each included study

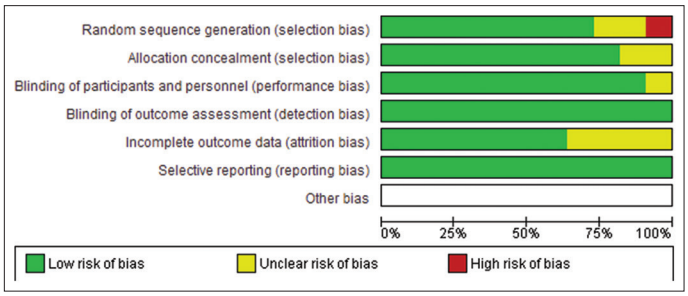

Figure 3: Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies

(HAZ), wasting (WAZ), and underweight (WHZ) in children under 0–5 years with severe to mild malnutrition.

Choudhary *et al*.[8] compared locally manufactured SNP branded as Pushti, containing unfortified mixture of toasted rice powder (26.3 g), roasted lentil powder (13.2 g), molasses (6.6 g), and vegetable oil (3.9 g); the total energy obtained from one 50 g Pushti packet was 188 kcal; against commercially available product, *Monimix micronutrient powder* (Renata Limited, Dhaka, Bangladesh), containing 12.5 mg of iron, 5 mg of zinc, 300 µg of Vitamin A, 150 µg of folic acid, and 50 mg of Vitamin C. The study was conducted in slums of Dhaka, Bangladesh.

Christian *et al*.[12] compared two locally produced lipid-based ready-to-use food rice-lentiland chickpea-based against international product, Plumpy'doz™. The study was conducted in rural Bangladesh, 18 Unions of the Gaibandha, and one Union of the Rangpur district.

Table 1: Details about the studies included in meta-analysis

Author	Methods	Participants	Interventions	Outcomes
Choudhury 2016	Two arm quasi-randomized control trial	Children aged 6–23 months WAZ score>1 from Bauniabadh section of Mirpur, a sub-district of the Bangladesh capital, Dhaka	Supplementary Nutrient Product (SNP)	Mean change in Z scores of Weight for Height (WHZ) and Height for Age (HAZ) at 1, 2, 3, 4, 5, 9, 12 months
Christian 2015	Five-armed Cluster Randomized trial	Children aged 6–18 months in Unions of Gaibandha and Rangpur District in Bangladesh	3 locally prepared SNP, 1 internationally prepared SNP measured against a control	Change in WHZ and LAZ measured at 18 months
Dewey 2017	Four-armed cluster randomized trial	Children aged 6–24 months in 11 rural unions of the Badarganj and Chirirbandar sub districts in northwest Bangladesh	Two iron and folic acid supplements and a lipid based nutrient supplement against an IFA control	Change in WHZ, LAZ and STH prevalence at 18 and 24 months by each intervention group
Gope 2019	Quasi-experimental study design	Children under 3 years of age in 7 districts of 4 states - Jharkhand, Odisha, Chhattisgarh and Bihar	Conducting Participatory Learning and Action (PLA) meetings and home visits in an area of 5000 population targeted at children aged 6 months–3 years	Prevalence of WAZ, WHZ and HAZ scores
Khan 2013	Maternal and Infant Nutrition Intervention Randomized Controlled trial	Pregnant women from Matlab, a rural sub-district in southeast Dhaka, Bangladesh	The three interventions were 30 mg Fe and 400 mg Folic acid, 60 mg Fe and 400 mg Folic acid and multiple micro nutrient supplements	Prevalence of WHZ, HAZ and WAZ score of children from birth till 54 months
Mridha 2016	Two arm cluster randomized controlled trial	Rural unions of the Badarganj and Chirirbandar sub districts of the northwest region of Bangladesh, 340 km northwest of Dhaka.	Comprehensive LNS group, child-only LNS group, child-only MNS group and control group	LAZ and WAZ of children by intervention group
Menon 2016	Two arm cluster randomized trial	Rural children 600 and 1090 children6–23.9 mo and 24–47.9 mo/ group, respectively were enrolled from Bangladesh	Intensified interpersonal counseling, community mobilization and mass media campaign	Changes in WHZ, WAZ and HAZ score from baseline to end line survey
Sazawal 2010	Two arm randomized controlled trial	Children aged 1-3 from Sangam Vihar, New Delhi	Micronutrient fortified milk group and non-micronutrient fortified milk group	Changes in WHZ, WAZ and HAZ score
Shafique 2016	2*2 factorial cluster randomized trial	Low birth weight (LBW) infants of two rural sub-districts of Palash in Narsingdi district and Kaliganj in Gazipur district of Dhaka, Bangladesh	In the first 6 months of infancy (0–5 months) children of all clusters were allocated to Hand Sanitizer (or) No hand sanitizer group. In the second 6 months of infancy children in the original two groups were re-allocated to either an Micro-nutrient powder (MNP) or no MNP group	Prevalence of LAZ, WLZ and WHZ from 0 to 12 months
Singh 2017	Two arm quasi-experimental randomized longitudinal study	Third trimester pregnant women from Uttar Pradesh were chosen and their children were followed up every 3 months from birth till 18 months	Breastfeeding and complementary feeding practices	Improvements in WAZ and LAZ scores at 3, 6, 9, 12, 15 and 18 months
Strand 2015	Four arm placebo controlled randomized trial	Children aged 6–35 months in Tigri and Dakshinpuri area of New Delhi	150 mg folic acid, 1.8 mg Vitamin B12, both folic acid and Vitamin B12, placebo	Differences in WAZ and HAZ from baseline until end of the study

Dewey *et al*.[13] compared locally developed lipid-based nutrient supplements (LNSs), given to children under 5 years, against *Monimix micronutrient powder* (Renata Limited, Dhaka, Bangladesh). The study was conducted in Bangladesh.

All the three studies were conducted on home-based management of malnutrition through frontline healthcare workers.

The forest plots were drawn for stunting, wasting, underweight for three studies, each intervention arm was individually included in the forest plots. Figure 4 presents the Forest plot of effect of Special Nutrition Products versus control on Z score for weight and age (underweight). The overall effect for underweight marginally favors commercially available or internationally produced SNPs over locally produced SNPs with mean difference of 0.08, (95% CI 0.04, 0.11). The test for heterogeneity has $P = 0.33$ and $I^2 = 12\%$, indicating low heterogeneity.

Figure 5 presents Forest plot of effect of Special Nutrition Products versus control on Z score for height and age

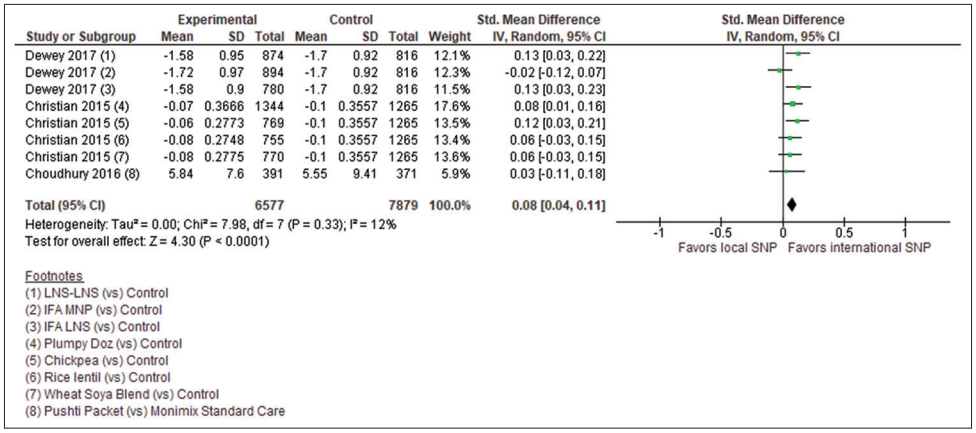

Figure 4: Forest plot of effect of special nutrition products versus control on Z score for weight and age

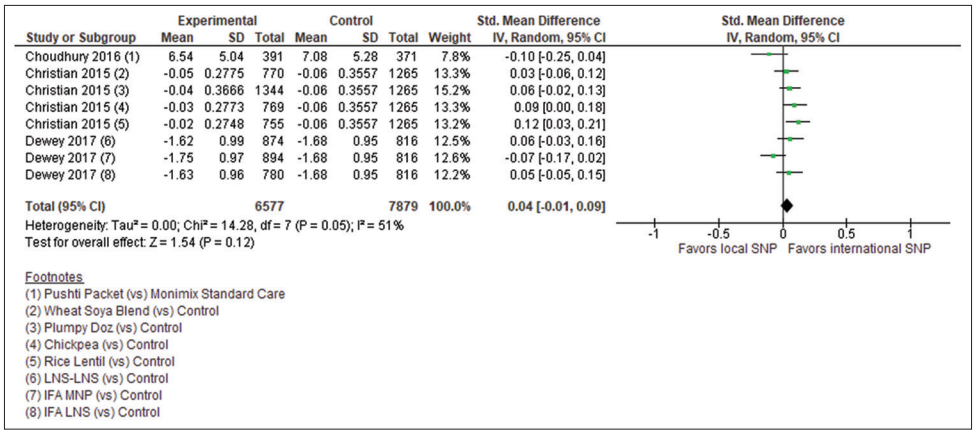

Figure 5: Forest plot of effect of Special Nutrition Products versus control on Z score for height and age

(Stunting). The overall effects for stunting were inconclusive for local SNP or International SNP with mean difference of 0.04, (95% CI −0.01, 0.09). The test for heterogeneity has $P = 0.05$ and $I^2 = 51\%$, indicating substantially heterogeneous.

Figure 6 presents Forest plot of effect on Special Nutrition Products versus control on Z score for weight and height (Wasting). The overall effects for wasting were marginally favoring International SNP over local SNP with mean difference of 0.08, (95% CI 0.04, 0.12). The test for heterogeneity has $P = 0.19$ and $I^2 = 31\%$, indicating low heterogeneity.

Information Education and Communication Intervention

Three articles presenting eight IEC intervention were compared to standard care for stunting (HAZ), wasting (WAZ), and underweight (WHZ) in children under 0–5 years with severe to mild malnutrition.

Gope *et al*.[9] compared home visits by Anganwadi works and community participatory learning, home visits creche services with provision for meals to children was compared to standard care provided at Anganwadi. The study was conducted in three blocks in Jharkhand (Gola, Khuntpani, and Ratu-Nagri) and two in Odisha (Thakurmunda and Saharpada). Menon *et al*.[14] compared intensified interpersonal counseling, community mobilization and mass media campaign against mass media campaign. The study was conducted in Bangladesh. Singh *et al*.[15] compared advanced training to ANMs and AWWs, AWWs and ANMs were trained to impart age-specific advice about breastfeeding at birth, including the importance of initiating breastfeeding within 1 h of childbirth, and withholding all other fluids or foods until 6 months of age. Workers were trained to encourage mothers to breastfeed frequently, on-demand, day and night, and increase the frequency of breastfeeding during and after illness. For children 6 ± 24 months of age, workers advised mothers to continue frequent, on-demand breastfeeding, and to increase the frequency of breastfeeding during illness. AWWs and ANMs were also trained to advise the child caregivers to introduce small amounts of home foods at age 6 months, gradually increasing the quantity and consistency after a few days such that, by 6 ± 8 months of age. The comparator arm was standard IEC through Anganwadi Centers.

The forest plots were drawn for stunting, wasting, underweight for three studies, each intervention arm was

individually included in the forest plots. Figure 7 presents the Forest plot of effect of IEC interventions versus Standard IEC on Z score for weight and age (underweight). The overall effect for underweight is inconclusive for Standard IEC or intensified IEC approaches with mean difference of 0.06, (95% CI −0.01, 0.12). The test for heterogeneity has $P = 0.13$ and $I^2 = 46\%$, indicating moderate heterogeneity.

Figure 8 presents the – Forest plot of effect of IEC versus control on Z score for height and age (Stunting). The overall effect for underweight is inconclusive for Standard IEC or intensified IEC approaches with mean difference of 0.01, (95% CI −0.04, 0.05). The test for heterogeneity has $P = 0.55$ and $I^2 = \%$, indicating low heterogeneity.

Figure 9 presents the – Forest plot of effect of IEC versus control on Z score for height and age (Wasting). The overall effect for underweight is inconclusive for Standard IEC or intensified IEC approaches with mean difference of −0.02, (95% CI −0.06, 0.03). The test for heterogeneity has $P = 0.42$ and $I^2 = 0\%$, indicating low heterogeneity.

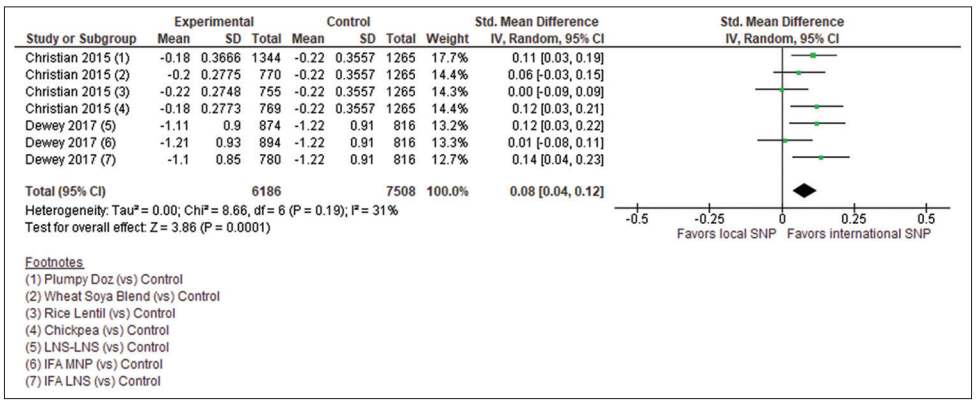

Figure 6: Forest plot of effect of Special Nutrition Products versus control on Z score for weight and height

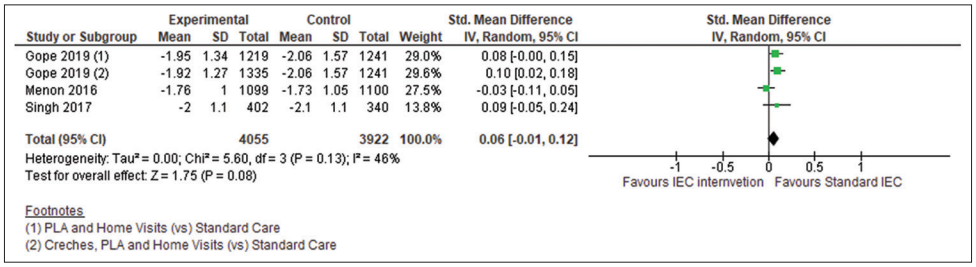

Figure 7: Forest plot of effect of IEC versus control on Z score for weight and age

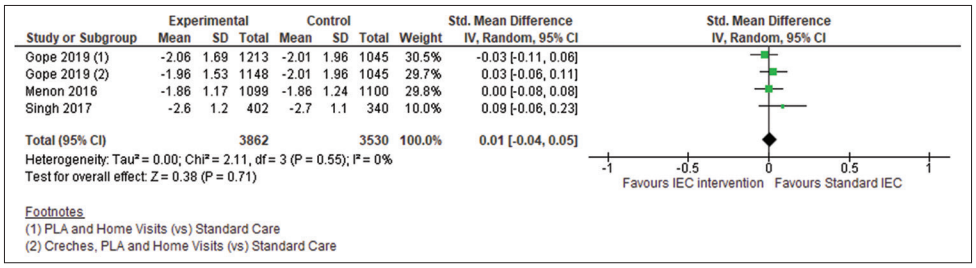

Figure 8: Forest plot of effect of IEC versus control on Z score for height and age

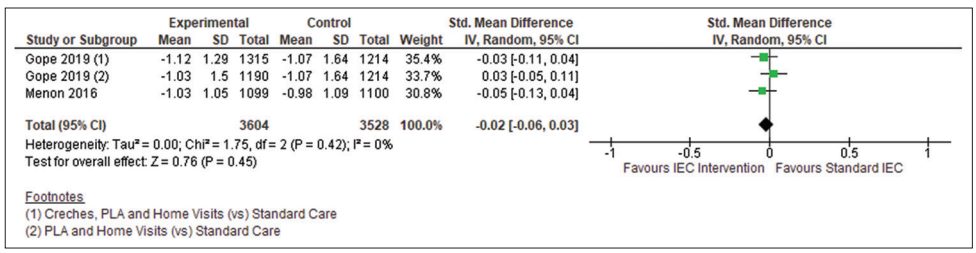

Figure 9: Forest plot of effect of IEC versus control on Z score for weight and height

Maternal Special Nutritional Product to Reduce Malnutrition Among Newborn

Three articles presenting nine interventions for maternal special nutritional product were compared to standard maternal care to reduce newborn malnutrition (stunting, wasting, and underweight).

Mridha *et al*.[11] compared LNS for pregnant and lactating women against iron and folic acid using Two arm cluster randomized controlled trial in Rural unions of the Badarganj and Chirirbandar sub districts of the northwest region of Bangladesh, 340 km northwest of Dhaka. Mridha *et al*. measured results only for Underweight and Stunting. Shafique *et al*.[16] conducted 2 × 2 factorial trail allocating the pregnant women from clusters were allocated to hand sanitizer (or) No hand sanitizer group and micro-nutrient powder (MNP) or no MNP group. Shafique *et al*. conducted measurement for stunting, wasting, and underweight. Khan *et al*.[10] compared maternal intervention of 30 mg Fe and 400 mg Folic acid, 60 mg Fe and 400 mg folic acid and multiple micronutrient supplements compared at different timeline of initiation of the intervention, 9 weeks of pregnancy, or 20 weeks of pregnancy onward.

Figure 10 presents the Forest plot of effect of Maternal SNP versus control on Z score for weight and age (underweight). The overall effect for underweight inclined for Standard Maternal Care over Maternal SNP with mean difference of 0.14, (95% CI 0.07, 0.21). The test for heterogeneity has $P = 0.44$ and $I^2 = 0\%$, indicating low heterogeneity.

Figure 11 presents the – Forest plot of effect of Maternal SNP versus control on Z score for height and age (Stunting). The overall effect for stunting inclined for Standard Maternal Care over Maternal SNP with mean difference of 0.10, (95% CI 0.05, 0.14). The test for heterogeneity has $P = 0.82$ and $I^2 = 0\%$, indicating low heterogeneity.

Figure 12 presents the – Forest plot of effect of Maternal SNP versus control on Z score for weight and height (Wasting). The overall effect for wasting is inconclusive for Standard Maternal Care or Maternal SNP with mean difference of 0.07, (95% CI −0.12, 0.27). The test for heterogeneity has $P = 0.17$ and $I^2 = 44\%$, indicating mild heterogeneity.

Micronutrient Supplements to Children Under 5 Years

Three articles presenting four interventions for micronutrient supplements to children under 5 year against standard care for reduction in stunting (HAZ), wasting (WAZ), underweight (WHZ).

Sazawal *et al*.[17] compared Fortified milk (3 servings/ day) designed to deliver additional amounts of zinc (7.8 mg), iron (9.6 mg), selenium (4.2 mg), copper (0.27 mg), Vitamin A (156 mg), Vitamin C (40.2 mg), and Vitamin E (7.5 mg) against the standard control milk powder providing

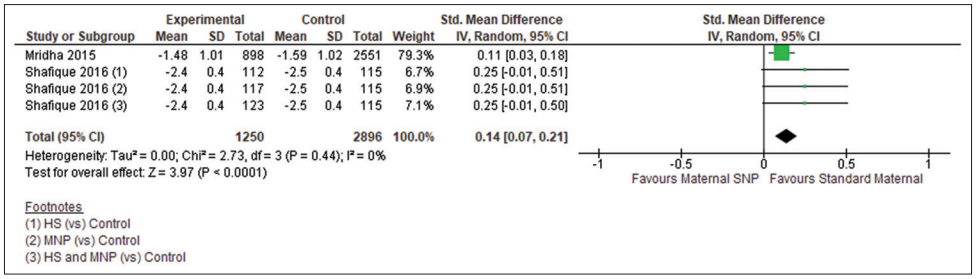

Figure 10: Forest plot of effect of Maternal SNP versus control on Z score for weight and age

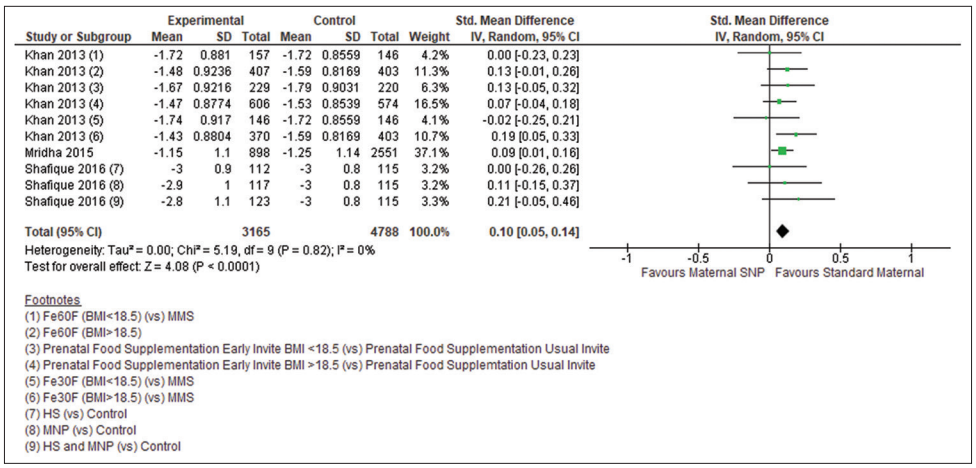

Figure 11: Forest plot of effect of maternal SNP versus control on Z score for height and age

natural levels of the specific micronutrients as in base milk without additional fortification of zinc or iron. The study was conducted in a peri-urban community located on the outskirts of New Delhi, India. Khan *et al*.[10] compared micronutrients Fe60F- 60-mg iron and 400-mg folic acid against MMS – multiple micronutrients, 15 micronutrients including 30-mg iron and 400-mg folic acid. Strand *et al*.[18] compared Vitamin B12 and folic acid against placebo in sub urban Delhi area.

Figure 13 presents the Forest plot of effect of micronutrient versus control on Z score for weight and age (underweight). The overall effect for underweight is inconclusive for Standard Care or Micronutrients with mean difference of 0.11, (95% CI −0.06, 0.29). The test for heterogeneity has $P = 0.001$ and $I^2 = 88\%$, indicating high heterogeneity among the studies included.

Figure 14 presents the Forest plot of effect of Micronutrient versus control on Z score for height and age (underweight). The overall effect for underweight is inconclusive for Standard Care or Micronutrients with mean difference of 0.14, (95% CI 0.00, 0.28). The test for heterogeneity has $P = 0.001$ and $I^2 = 88\%$, indicating high heterogeneity.

Figure 15 presents the – Forest plot of effect of Micronutrient versus control on Z score for weight and height (Wasting). The overall effect for wasting is inconclusive for Standard Care or Micronutrient with mean difference of 0.86, (95% CI −0.69, 2.42). The test for heterogeneity has $P = 0.00001$ and $I^2 = 100\%$, indicating high heterogeneity.

Overall the results from meta-analysis across various interventions for reduction in underweight, stunting, and wasting were inconclusive.

For reduction in burden of underweight in children, commercially available SNPs were showing higher reduction than locally manufactured, for Maternal SNP the standard maternal care (iron folic tablets) provided higher reduction than Lipid bases SNP. For IEC and results did not favor intervention and control, whereas for micronutrient the heterogeneity among the studies.

For reduction in burden of stunting in children, equal reduction was seen between locally produced and commercially available SNPs. Target IEC and Standard IEC also had similar effects. Maternal SNP given at 20 weeks

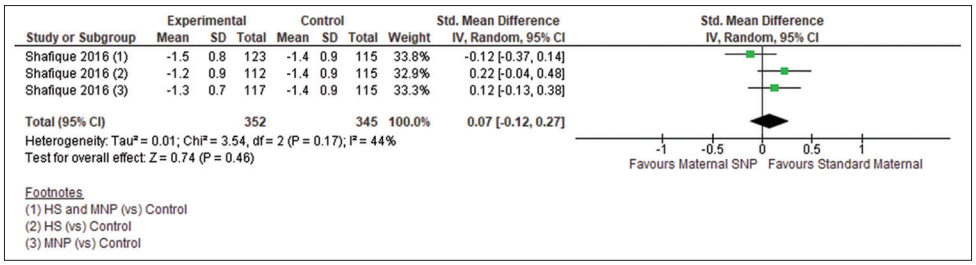

Figure 12: Forest plot of effect of Maternal SNP versus control on Z score for weight and height

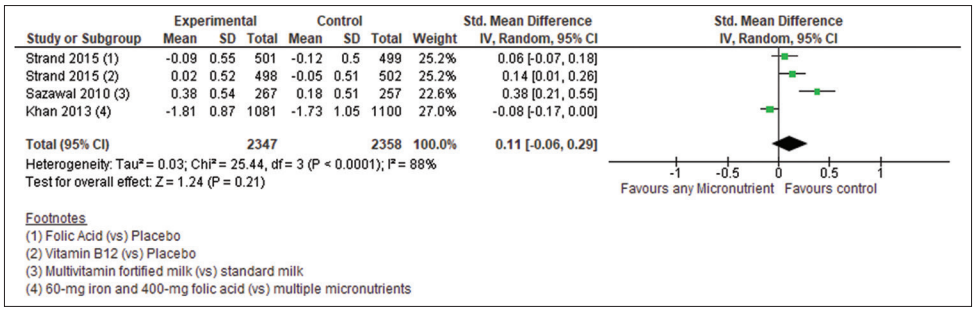

Figure 13: Forest plot of effect of Micronutrient versus control on Z score for weight and age

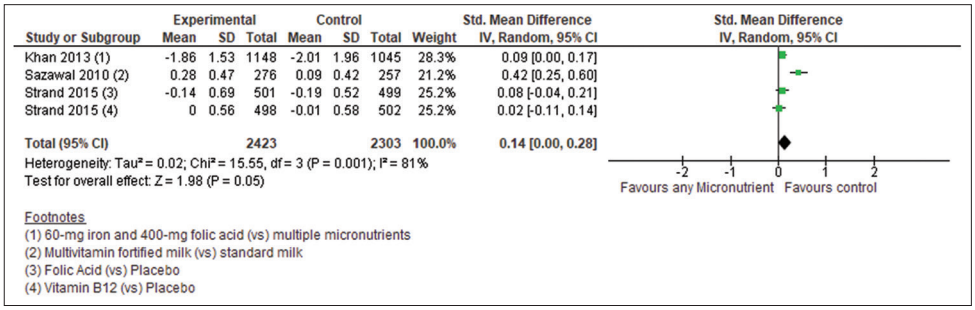

Figure 14: Forest plot of effect of micronutrient versus control on Z score for height and age

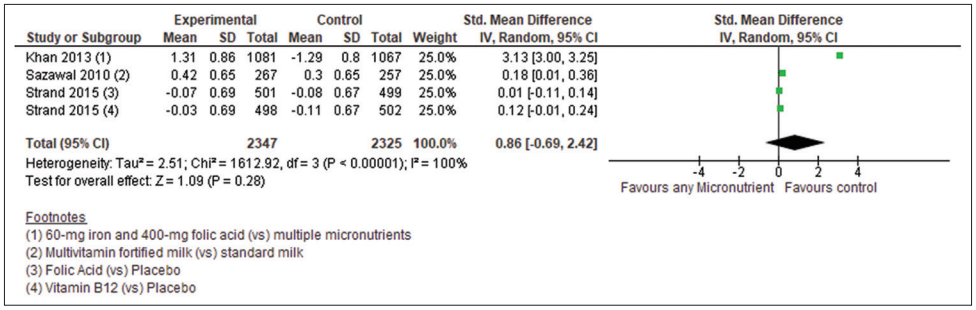

Figure 15: Forest plot of effect of Micronutrient versus control on Z score for weight and height

yielded better reduction than Maternal SNP given at 9 weeks of pregnancy. The micronutrient interventions results were showing high heterogeneity.

For reduction in burden of wasting in children, commercially available SNPs were showing better reduction than locally manufactured SNPs. Targeted IEC and Standard IEC had similar effects. Maternal SNP and Standard Care had similar effects. Multiple micronutrients intervention has shown higher reduction compared to Vitamin B12 or folic acid only.

DISCUSSION

The analysis of this study was undertaken with an objective to identify best practices from SAARC countries. For SNP to children interventions, overall effect for underweight marginally favors commercially available or internationally produced SNPs over locally produced SNPs with mean difference of 0.08, (95% CI 0.04, 0.11), $I^2 = 12\%$. Overall effects for wasting were marginally favoring International SNP over local SNP with mean difference of 0.08, (95% CI 0.04, 0.12), $I^2 = 31\%$. For Maternal SNPs, overall effect for underweight inclines for Standard Maternal Care over Maternal SNP with mean difference of 0.14, (95% CI 0.07, 0.21), $I^2 = 0\%$. Overall effect for stunting inclines for Standard Maternal Care over Maternal SNP with mean difference of 0.10, (95% CI 0.05, 0.14), $I^2 = 0\%$. IEC interventions presented inconclusive results. Micronutrient interventions had heterogenous data.

This review to the best of our knowledge is a first attempt to comprehensively look at the overall gambit of various interventions for prevention and management of malnutrition in SAARC countries. A recently published meta-analysis by Das *et al*.[19] analyzed 42 studies from low-income and low- and middle-income countries to understand the effectiveness of interventions in the management of acute malnutrition in children under 5 years of age. The findings of the meta-analysis are similar to our study, suggesting the commercially available SNPs marginally better than locally manufactured SNPs.[19] Higher Gain in weight was demonstrated for commercially available or internationally manufactured SNPs as compared to locally manufactured SNPs. Another meta-analysis by Lenters *et al*.[20] analyses two studies for understanding the effect of locally manufactured SNPs against internationally manufactured (Commercially available) SNPs found similar effect across both the arms. Meta-analysis for IEC interventions, effects of maternal SNP on nutrition status of newborn child were not found during our search.

This study covers various aspects of prevention and management of malnutrition and presents the interventions which can be invested in future to get better results. The study compares standard management practices against new or tweaked practices with perceived benefit over the standard practices to understand the improvement in weight and height. Most of the studies included were of good quality.

Our study has its own limitations, as the meta-analysis for micronutrient yielded highly heterogeneous findings. Most of the multiple arms and thus studies were classified into various categories repeatedly which has led to less heterogeneity to certain level for Maternal SNP category. Majority of the studies were reported from Bangladesh and India. Studies reported from Pakistan and Nepal were mostly using non-experimental methodology hence excluded from the study. No studies were found from Bhutan, Sri Lanka, Maldives, and Afghanistan.

The findings of the study incline toward the current practices followed by the health systems in the respective country. The evidence from our study is inconclusive to identify interventions as best practice; however, it adds to the knowledge that local SNPs and commercially available SNPs have similar effect in weight gain. Targeted IEC approach or the standard community approach had similar effect. Maternal SNP programs indicated improved nutritional status of mother who received some kind nutrition from meals in Anganwadi centers with Iron folic acid tablets. However, when nutrients were given singularly had lesser effect than combination of nutrients. Micronutrient Vitamin B12 had no effect on nutrition status. Iron and folic acid supplement has shown to improve nutritional status among the children.

CONCLUSION

From our study, the identification of best practices did not provide evidence to back any specific intervention

over standard practice. The standard care offered through Integrated Child Development Programme provides all-inclusive coverage in management of malnutrition among children under 5 years of age.

Our study findings indicate need to improve the implementation of current programs, newer interventions play limited role in management or prevention of malnutrition. More studies must be designed to develop interventions that would aid monitoring and evaluation of current practices, implementation of digital technologies to improve data collection, and management techniques. IEC approaches need to be redesigned using principles of consumer health informatics training of front-line health workers.

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ANNEXURE A – SEARCH STRATEGY

#1 Search (((young children) OR infants) OR Children) OR age 0–5 years
#2 Search (((Malnutrition) OR undernutrition) OR wasting) OR stunting
#3 Search ((((ICDS) OR Integrated Child Care) OR Nutrition) OR WASH) OR (water and sanitation)
#4 Search ((((India) OR Bangladesh) OR Nepal) OR Pakistan) OR Sri Lanka
#5 Search (((((((young children) OR infants) OR Children) OR age 0–5 years)) AND ((((Malnutrition) OR undernutrition) OR wasting) OR stunting)) AND (((((ICDS) OR Integrated Child Care) OR Nutrition) OR WASH) OR (water and sanitation))) AND (((((India) OR Bangladesh) OR Nepal) OR Pakistan) OR Sri Lanka)