Evaluation of Multiple Micronutrient Supplementation Programme in Sri Lanka

2009-2012

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CI	Confidence Interval
DHS	Demographic and Health Survey
HAZ	Height for Age Z score
Hb	Haemoglobin
IDA	Iron Deficiency Anaemia
MMN	Multiple Micro-Nutrient
MoH	Ministry of Health
NFSS	Nutrition and Food Security Survey
NNMS	National Nutrition and Micronutrient Survey
OR	Odds Ratio
RR	Relative Risk
RCT	Randomised Controlled Trial
WAZ	Weight for Age Z score
WHZ	Weight for Height Z score
WMD	Weighted median

Executive summary

Information on nutritional status in Sri Lanka indicates that micro nutrient deficiencies – the hidden hunger may be a more serious problem to consider than energy deficiency per se. Three types of micronutrient deficiencies have been considered as major problems in Sri Lanka – iron, vitamin A and iodine deficiency.

Proven nutrition-related interventions offer many possibilities for improvement of under-nutrition in mothers and their children, and reduction of the related burden of disease in both the short and the long terms. A systematic review of scientific evidence has proven that dispersible micronutrient preparations for home fortification reduce anemia by 34%, iron deficiency anaemia by 57% and retinol deficiency by 21%. Multiple micronutrient (MMN) supplementation for infants and young children was introduced to the national maternal and child health programme in Sri Lanka with the support of UNICEF in 2007. The intervention is currently being implemented in 12 of the most nutritionally vulnerable districts; namely Nuwaraeliya, Badulla, Moneragala, Trincomalee, Baticaloa, Ampara, Jaffna, Kilinochchi, Mannar, Mullaitivu, Vavuniya and Hambantota. The children aged 6 to 23 months are eligible to receive MMN supplement, given in a sachet as a powder for home fortification of the child's meal. According to the current schedule recommended since March 2012, a child should receive MMN supplement on completion of 6, 12 and 18 months, daily for 60 days on each occasion.

The purpose of the present evaluation is to assess the need, effectiveness, efficiency and sustainability of MMN supplementation programmes in the 12 intervention districts including a comparison between recipients and non-recipients. The evaluation would provide policy and programmatic recommendations to guide future decision making on scaling up of the MMN supplementation programmes in other nutritionally vulnerable districts. Two approaches were used for the evaluation: (1) Literature review focusing on wide range of concerns including micronutrient status, efficacy of MMN supplements, need for the MMN supplementation programme and criteria for targeting; (2) Secondary data analysis of 2 national surveys conducted early and late phases of the MMN intervention. The secondary data analysis employed data from the Nutrition and Food Security Survey 2009 (NFSS 2009) and the National Nutrition and Micronutrient Survey 2012 (NNMS 2012).

According to the Nutrition Guidance Expert Advisory Group (NUGAG) convened by the WHO, home fortification of foods with micronutrient powders is recommended for the populations where the prevalence of anaemia in children under 2 years or 5 years of age is 20% or higher. According to NNMS 2012, the national prevalence of anaemia for children under 2 years (6-23 months) was 26.5% which is higher than the NUGAG threshold. The overall prevalence for children under 5 years (6-59 months) was 15.1%. Although a low prevalence of anaemia was reported for the under-5 year group, the corresponding figure for the younger age group was above 20% threshold. Further, in 20 out of the 25 districts, the prevalence was above 20% within the younger age category.

The analysis also revealed that only 45.2% of the children in the age group 6-23 months in the 12 intervention districts have received MMN powder in 2012. Of the recipients, the majority of them has taken MMN powder between the ages of 6 and 12 months (85%), and used it either daily or every other day (89.4%). When all children aged 6-23 months in the 12 districts are considered, approximately one-third of the target population has taken MMN appropriately.

In order to evaluate the effectiveness of the programme, a pre- and post-intervention comparative analysis was performed between NFSS 2009 and NNMS 2012. This was restricted to the 8 districts that were covered in both surveys. The results showed a significant and substantial reduction in the prevalence of anaemia in children aged 6-23 months by 11.7%, and an increase in mean Hb level by 0.3 g per dl between 2009 and 2012.

Using the NNMS 2012 data, the micronutrient status was compared between children who received MMN and never received MMN in the 12 intervention districts. The results revealed that the prevalence of anaemia was lower (25.2%) among those who have received MMN powder compared to those who haven't received it (29.7%), but this difference was statistically non-significant. However, there was a statistically significant reduction in the prevalence of Iron Deficiency Anaemia among recipients of MMN (10.1%) in comparison to non-recipients (15.7%). There is also a significant improvement in the mean Haemoglobin level by 0.15 g per dl in the recipients. However, it should be noted that there were no significant differences in the serum ferritin or Zn levels between recipients and non-recipients. Also, the present analysis did not show any significant association between receipt of MMN and any of the anthropometric outcomes – stunting, wasting or underweight. Further local evidence for effectiveness of MMN supplementation was derived through a nutrition survey carried out in the Northern Province in 2012. The study reported that children aged 6-23 months who did not receive MMN supplements having a significantly higher risk for anaemia in contrast to the recipients, with an adjusted Odds Ratio of 1.9.

The review looked into policy and programmatic aspects too. The Government of Sri Lanka receives high level policy support for MMN supplementation to control micronutrient deficiencies in young children in vulnerable populations. The National Nutrition Policy promotes food fortification to ensure micronutrient supplementation for vulnerable groups. One of the five key results areas of the Multi-Sector Action Plan for Nutrition is to reduce prevalence of aneamia by 50% from the 2012 figures. The Family Health Bureau of the Ministry of Health, in collaboration with provincial health authorities and district health staff, implements the MMN programme in Sri Lanka. Since the country has a well-established maternal and child health programme up to the grass-roots level, the delivery of the MMN has been well integrated to this existing system. One of the major constrains of the programme is poor coverage of MMN supplements, where more than half of the target population has not received MMN in the 12 pilot districts. To date, there is no valid and reliable mechanism to monitor the MMN supplementation programme within the health system.

The present evaluation has demonstrated that MMN supplementation for home fortification has clear benefits in reducing Iron deficiency anaemia in infants and young children in the pilot districts. In conforming to global guidelines, it is recommended that prevalence of anaemia more than 20% in the age group 6-23 months be used as the cut-off in determining scale up of MMN supplementation programmes to other districts. Since coverage of MMN is less than 50%, with poor compliance, there is a need to promote greater acceptance of multiple micronutrient powders for home fortification of foods consumed by infants and young children. It is also recommended that valid indicators be developed to monitor MMN supplementation and compliance, and be built into routine health information systems and periodic household surveys. There is also a need to streamline the procurement, supply chain and distribution process of MMN powder sachets to ensure a uninterrupted supply.

Background

Micronutrient deficiency

Vitamin and mineral deficiencies affect over 2 billion people worldwide. Iron, Vitamin A, Iodine and Zinc are the most common micronutrient deficiencies globally (WHO 2011). The majority affected by micronutrient deficiencies are children; mainly due to their rapid growth and poor dietary practices. Micronutrient deficiencies in children could remain hidden for prolonged periods of time before developing clinical symptoms and signs. Such 'dormant' states of micronutrient deficiencies could cause irreversible damage to the growing child and it is important that we anticipate such deficiencies early and take timely steps to intervene (Wickramasinghe 2011).

Micronutrient deficiencies in Sri Lanka

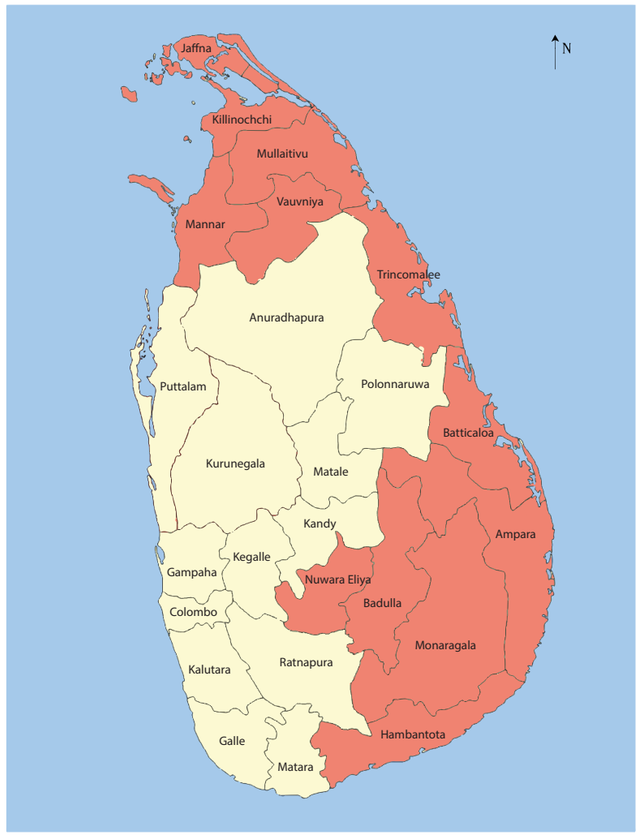
Available data on the nutritional status at the community level in Sri Lanka indicate that micro nutrient deficiencies – the hidden hunger may be a more serious problem to consider than energy deficiency alone. Three types of micronutrient deficiencies have been accepted as major problems in Sri Lanka – Iron, Vitamin A and Iodine. Iron deficiency anaemia is widespread, with prevalence being particularly high in infants (40 - 60 percent), followed by a lower level in pre-school children (15 - 25 percent). Amongst women and mothers, 20 - 30 percent have iron deficiency anaemia with significantly higher levels found amongst certain population groups, such as those living in the estate sector. Iodine deficiency, manifested in goitre, affected 19 percent of school children in the 1980s. However, after the introduction and strengthening of the salt iodisation programme at national level, current goitre level in school children stands at 4 - 5 percent (2010/11). Vitamin A deficiency was a serious problem in the 1930s, but the implementation of the milk programme was successful in bringing down the prevalence of severe deficiency (night blindness, keratomalacia) from 60 percent in the 1930s to seven percent in the 1960s, and less than one percent in the 1970s. Vitamin A supplementation was introduced through the Maternal and Child Health Programme in 2001, and has further reduced prevalence. However, the most recent national survey in 2006 found that 30 percent of children suffered from Vitamin A deficiency, as reflected in blood levels, and that this continues to be a problem, largely owing to inadequate intake of Vitamin A-rich foods.

Multiple micronutrient powders for home fortification of foods consumed by infants and children 6–23 months of age

Proven nutrition-related interventions offer many possibilities for the reduction of undernutrition in mothers and their children, and the curtailment of related diseases in both the short and long term. The Lancet 2008 series on interventions for maternal and child undernutrition and survival revealed that dispersible micronutrient preparations for home fortification have resulted in a significant effect on haemoglobin level (Reduction in WMD 5.68 g per dl; 95%CI: 1.78–9.57) and iron-deficiency anaemia (relative risk 0.54, 95%CI: 0.42–0.70) compared with placebo in young children (Bhutta et al 2008 Lancet). Currently, micronutrient powders are increasingly in use at scale in programmes to address iron and multiple micronutrient deficiencies in children. A recent systematic review of 17 random controlled trials from developing countries estimated that these powders significantly improved haemoglobin concentration, while reducing iron deficiency anaemia (IDA) by 57% and retinol deficiency by 21% (Salam et al. 2013). The review also reported no evidence of benefit on linear growth.

Multiple micronutrient supplementation programme for children in Sri Lanka

Figure 1: Districts where MMN programme is implemented currently in Sri Lanka



*MMN supplementation districts are highlighted in red

MMN supplementation for children was introduced in Sri Lanka with the support of UNICEF on a pilot basis in four of the most nutritionally vulnerable districts; namely Nuwaraeliya, Badulla, Moneragala, and Trincomalee in 2007 (Ministry of Healthcare and Nutrition, 2007 General circular 1-34-2007). Subsequently, this was expanded to the districts of Baticaloa and Ampara in the Eastern Province, Hambantota in the Southern Province, and Jaffna, Kilinochchi, Mannar, Mullaitivu, and Vavuniya in the Northern Province; making 12 beneficiary districts in total as of date. Figure 1 illustrates the 12 districts where the MMN prgramme is being implemented at present. From its inception, the MMN supplementation programme has been integrated to the existing maternal and child health programme. It has been implemented through Medical Officers of Health in the periphery.

Children aged 6 to 23 months are eligible to receive the MMN supplement. It is given in a sachet (as a powder) for the fortification of a child's meal at home. Until March 2012, the recommended regimen was one sachet of MMN every other day for a period of 4 months, ideally on completion of 6 months of age, as recommended by the Ministry of Healthcare and Nutrition (2007). It is recommended that the content of the whole sachet be added to a small quantity of semi-solid or solid food, mixed well, and fed to children. The schedule for MMN supplementation was revised in March 2012 (Family Health Bureau, Ministry of Health 2012). According to the new schedule, a child should receive the MMN supplement upon completion of 6, 12 and 18 months, daily for 60 days on each occasion.

The minimum recommended composition is 12.5 mg of elemental iron (equals 37.5 mg of ferrous fumarate, 62.5 mg of ferrous sulfate heptahydrate or 105 mg of ferrous gluconate), 300 µg of retinol and 5 mg of elemental zinc (preferably zinc gluconate) (WHO 2011). Many combinations of micronutrients can be used in multiple micronutrient (MMN) powders, and the present preparation used in Sri Lanka contains 15 micronutrients including 10 mg of iron, 400 µg of retinol, and 4.1 mg of zinc (refer Annex 1).

Evaluation Purpose, Objective and Scope

The purpose of the study is to conduct a secondary data analysis to assess the need, effectiveness, efficiency and sustainability of the MMN supplementation programme in the 12 intervention districts, and includes a comparison between recipients and non-recipients.

Specific objectives

- To assess the need, effectiveness, efficiency and sustainability of the current MMN supplementation programme.
- To provide policy and programmatic recommendations to guide policy makers in future decision making on scaling up of the MMN supplementation programme in other nutritionally vulnerable districts.

Evaluation Methodology

Two approaches were used for the evaluation of the MMN supplementation programme with special emphasis on need, effectiveness, efficiency and sustainability.

A. Review of available documents

A literature review was conducted through electronic searches of databases (PubMed, HINARI, Web of Science and Google Scholar) and hand searches of literature from libraries of Postgraduate Institute of Medicine, Ministry of Health, Medical Research Institute, WHO, UNICEF and other relevant institutions. The review focused on a wide range of concerns including micronutrient status, efficacy of MMN supplements, need for the MMN supplementation programme, and criteria for targeting. The factors that would affect sustainability (such as policy support, strategic plans and programmatic issues, delivery platforms and compliance with the suggested scheme, as well as costs) were also explored in this review.

B. Secondary data analysis of 2 national surveys conducted early (2009) and late (2012) phases of intervention

Data sources

The analysis employed data from the Nutrition and Food Security Survey 2009 (NFSS 2009) and National Nutrition and Micronutrient Survey 2012 (NNMS 2012). Both these surveys were conducted by the Medical Research Institute of the Ministry of Health in collaboration with UNICEF. The NFSS 2009 used a multi-stage cluster sample of 6071 households covering 12 districts representing 9 provinces in Sri Lanka. The NNMS 2012 used a multi-stage cluster sample of 7306 households representing all 25 districts of the country. In both surveys, anthropometric measurements of children were taken according to standard WHO protocol using recommended equipment, and haemoglobin using HCN method. The details of the sampling procedure, measurements, collection and transfer of blood samples, laboratory procedure, and questionnaire survey are available in the respective reports (Medical Research Institute, UNICEF, & WFP 2010; Medical Research Institute 2012).

Data analysis

Data was analysed using Stata (Version 11.0) statistical software. In order to see the effectiveness of the programme, a pre- and post-intervention analysis was performed between NFSS 2009 and NNMS 2012. The indicators compared were the prevalence of stunting, wasting, underweight and anaemia among infants and young children within the ages of 6-23 months. Comparison of mean HAZ, WHZ, WAZ, and Haemoglobin levels were also carried out for the same age group. The analyses were restricted to 8 districts where the MMN supplementation programme had been implemented, and where data is available from both surveys. Ninety-five percent confidence intervals (95% CI) were calculated for indicator variables and the statistical significance for difference was determined using either chi-square test or independent samples t-test, with $p<0.05$ to be considered statistically significant.

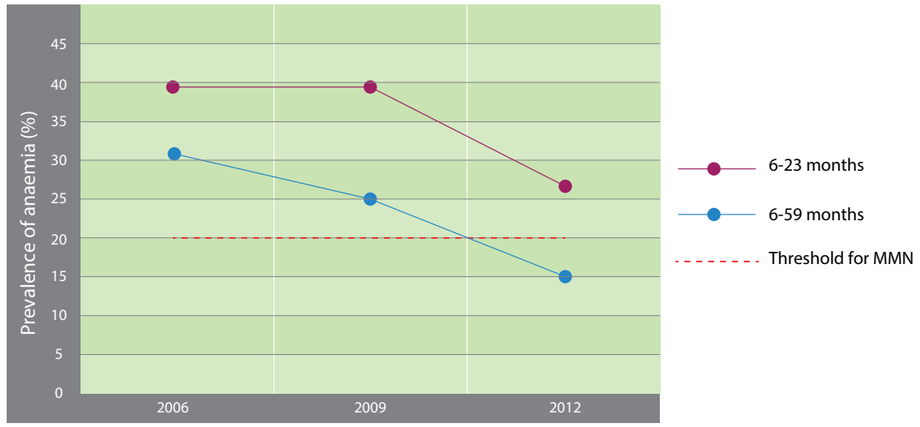
Using only the NNMS 2012, the micronutrient status was compared between children who received MMN and did not receive MMN in the intervention districts. This comparison covered all 12 intervention districts and included iron and Zn status in addition to the indicators mentioned above. An attempt was made to define 'appropriate use of MMN' as those children who received MMN powder during the age of 6-12 months, daily or every other day. The comparison of micronutrient status was performed in the same manner as described above between those who used it appropriately or did not.

Results

A. Is there a need for MMN supplementation?

The Nutrition Guidance Expert Advisory Group (NUGAG) convened by the WHO has reviewed the MMN supplementation programmes globally (WHO 2011). The NUGAG strongly recommends home fortification of foods with micronutrient powders containing at least iron, vitamin A and zinc to improve iron status and reduce anaemia among infants and children 6–23 months of age (WHO 2011). Home fortification of foods with micronutrient powders is recommended for populations, where the prevalence of anaemia in children under 2 years or under 5 years of age is 20% or higher. In Sri Lanka the prevalence rates of anaemia were higher than this level in 2006, and the corresponding rates are shown for under 2 year (6-23 months) and under 5 year (6-59 months) separately in Figure 2. Although the latest survey indicated a low prevalence of anaemia for the whole group (15.1% in 6-59 months), the corresponding figure for the younger age group was above 20% cut-off (26.5% in 6-23 months). As shown in Figure 3, there are 20 out of the 25 districts where the prevalence was above 20% within this age category.

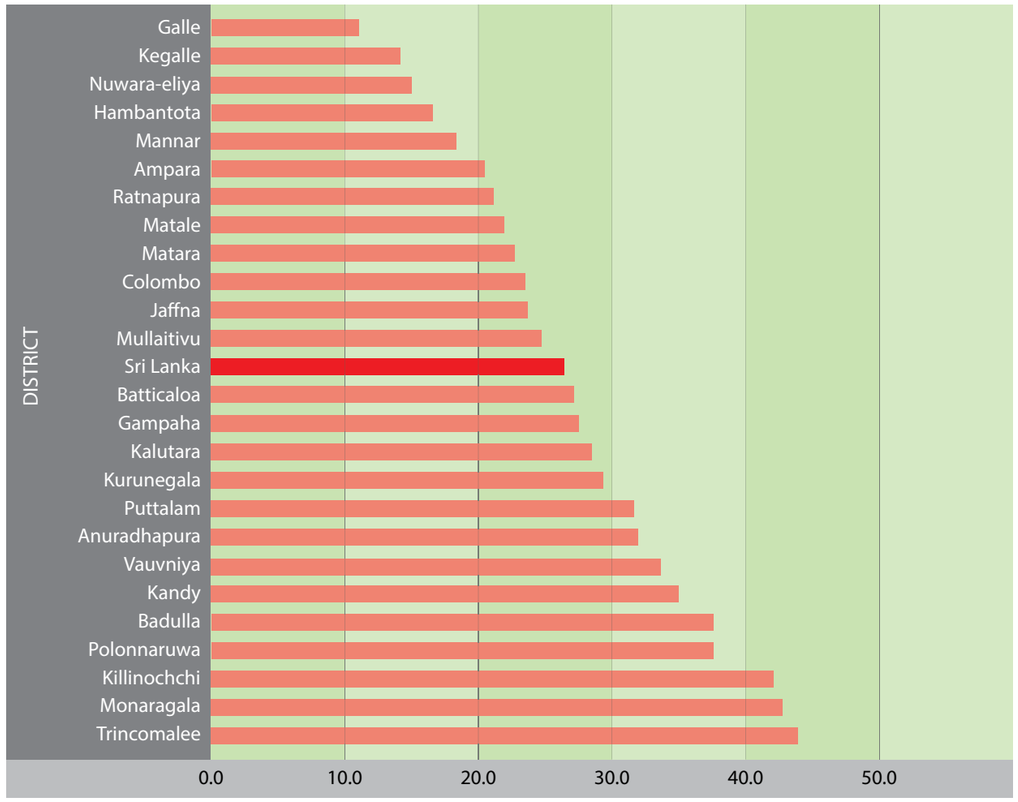
Figure 2: Trends in the prevalence of anaemia in the age groups 6-23 months and 6-59 months in Sri Lanka, between 2006 and 2012



Sources of data: DHS 2006/7; NFSS 2009; NNMS 2012

Age category	DHS 2006/07	NFSS 2009	NNMS 2012
6-23 months	39.4	39.4	26.5
6-59 months	31.1	25.2	15.1

Figure 3: Prevalence of anaemia in children aged 6 to 23 months by districts, NNMS 2012 (n=2176)



A review of literature by Wickramasinghe (2013) highlighted the importance of multiple micronutrient supplementation as an effective preventive strategy to address micronutrient deficiencies and their adverse consequences among young children in Sri Lanka. The factors that may contribute to low haemoglobin levels at a younger age include higher degrees of maternal anaemia, high rates of exclusive and partial breast feeding and low intake of iron rich and fortified food in the local setting. The review recommends screening for anaemia at any time after six months of age or having medicinal iron supplementation.

B. Efficacy of MMN – evidence through systematic review

There is evidence from a Cochrane review that MMN powder was effective for reducing anemia and iron deficiency for children under 2 years of age (DeRegil et al 2011). Home fortification with MMN powder reduced anaemia by 31% (six trials, RR 0.69; 95% CI 0.60 to 0.78) and iron deficiency by 51% (four trials, RR 0.49; 95% CI 0.35 to 0.67) in infants and young children when compared with no intervention or placebo. The review did not find an effect on growth, and there were no deaths reported in the trials. It concludes

that the use of MNP is efficacious among infants and young children 6 to 23 months of age living in settings with different prevalences of anaemia and malaria endemicity (DeRegil 2011).

A recent systematic review looked into 17 randomized controlled trials published up to November 2012 and conducted in developing countries for efficacy of MMN powders (Salam et al 2013). The significant effects of MMN powders on nutritional outcomes in children are summarised in Table 1. MMN powder significantly reduced the prevalence of anemia by 34%, iron deficiency anemia by 57% and retinol deficiency by 21%. It also significantly improved the hemoglobin levels. MMN powder was associated with a significant increase in diarrhea. Non-significant effects were found on serum ferritin, zinc deficiency, stunting, wasting, underweight, HAZ, WAZ, WHZ, fever, and upper respiratory infections.

Table 1: Effect size of micronutrient powders (MNP) in women and children: Systematic review of RCTs

Effect	Effect size – RR (95%CI)
Reduced anaemia	0·66 (0·57–0·77)
Reduced iron deficiency anaemia	0·43 (0·35–0·52)
Reduced retinol deficiency	0·79 (0·64–0·98)
Improved haemoglobin concentrations	SMD[a] 0·98 (0·55–1·40)
Diarrhoea	1.04 (1.01–1.06)

[a]SMD = standardized median value

Source: *Salam RA, MacPhail C, Das JK, Bhutta ZA.. BMC Public Health (2013).*

C. Efficiency of MMN supplementation programmes

Global review of nutrition-specific interventions

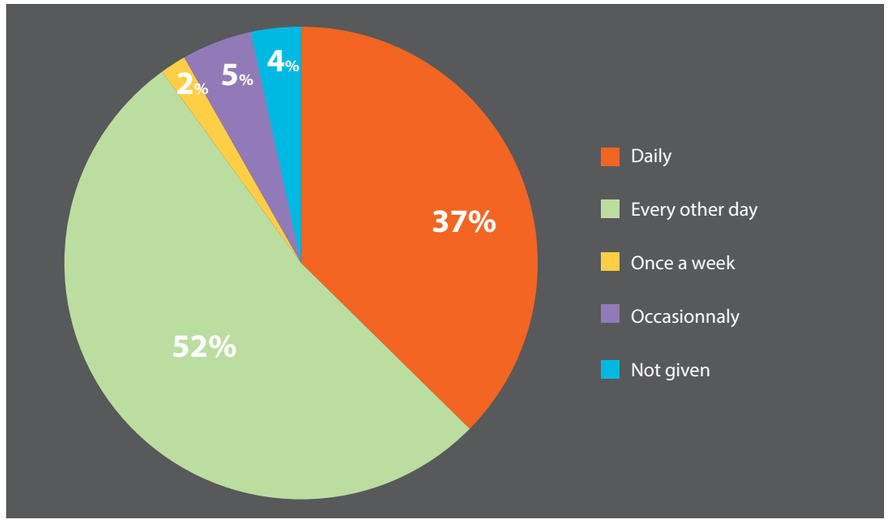
The latest Lancet series on maternal and child nutrition provides a comprehensive review to address undernutrition and micronutrient deficiencies in women and children (Bhutta et al 2013). The review concludes that the maximum effect on lives saved is noted with management of acute malnutrition (435 000 [range 285 000–482 000] lives saved); 221 000 (135 000–293 000) lives would be saved with delivery of an infant and young child nutrition package, including breastfeeding promotion and promotion of complementary feeding; and micronutrient supplementation (Vitamin A, and Zinc separately) could save 145 000 (30 000–216 000) lives. MMN supplementation for young children is not included among the ten most-effective nutrition interventions that were modelled to achieve a 15% reduction in child mortality if 90% coverage is accomplished. Despite, there is strong evidence that MMN powders significantly improve haemoglobin concentration and reduce iron deficiency anaemia. The review also revealed that only a few resource-poor countries have clear policies in support of integrated strategies to control micronutrient deficiencies among young children.

MMN powder usage in the intervention districts in Sri Lanka in 2012

According to NNMS 2012, only 45.2% of the children in the age group 6-23 months in the 12 districts had ever received MMN powder. Of the recipients, the majority (85%) had received MMN powder between the ages 6 and 12 months, while 13.6% between 13 and 18 months and a small percentage (1.8%) between 19 and 24 months.

Figure 4 illustrates how frequently MMN powder was added to children's meals. More than half of the recipients (52.5%) stated that it was added to the child's diet every other day (as per recommendation), while 36.9% stated that it was added daily. However, as far as the total beneficiaries are concerned, the proportion of children aged 6-23 months who received MMN powder, either daily or every other day, was 34.7%. This is unsatisfactory, due to the fact that the majority (54.8%) had not received MMN powder.

Figure 4. Frequency of adding MMN powder to diet among children aged 6-23 months who received it in the 12 intervention districts, NNMS 2012



D. Effectiveness of the MMN programme in Sri Lanka

Comparison between NFSS 2009 and NNMS 2012

In the NFSS 2009, data was available for the districts of Badulla, Moneragala, Trincomalee, Ampara, Nuwaraeliya, Jaffna, Hambantota and Vavuniya out the MMN intervention districts; therefore, comparison was restricted to these 8 districts.

Table 2: Comparison of undernutrition and anaemia in children aged 6-23 months in selected intervention districts[a] between 2009 and 2012

Indicator	NFSS 2009			NNMS 2012		
	N (non-weighted)	Prevalence (%)	95% CI	N (non-weighted)	Prevalence (%)	95% CI
Stunting	729	21.2	[17.4,25.5]	762	16.9	[14.2,20.1]
Wasting	729	6.3*	[4.4,9.1]	762	16.0*	[13.4,19.1]
Underweight	729	14.7	[11.5,18.4]	762	19.6	[16.7,22.8]
Anaemia	737	39.2*	[34.5,44.2]	734	27.5*	[24.2,31.1]

[a] Badulla, Moneragala, Trincomalee, Ampara, Nuwaraeliya, Hambantota, Jaffna, and Vavuniya- districts.
* P <0.05, according to chi-square test

Table 3: Comparison of HAZ, WHZ, WAZ, and Haemoglobin levels, in children aged 6-23 months in selected intervention districts[a] between 2009 and 2012

Indicator	NFSS 2009			NNMS 2012		
	N (non-weighted)	Mean	95% CI	N (non-weighted)	Mean	95% CI
HAZ	738	-0.83	[-1.02, -0.64]	762	-0.81	[-0.91, -0.70]
WHZ	737	-0.67*	[-0.79, -0.55]	762	-0.95*	[-1.03, -0.86]
WAZ	741	-0.93	[-1.05, -0.81]	762	-1.10	[-1.19, -1.02]
Hb	446	11.32*	[11.19, 11.46]	734	11.62*	[11.54, 11.71]

[a]Badulla, Moneragala, Trincomalee, Ampara, Nuwaraeliya, Hambantota, Jaffna, and Vavuniya- districts.
* P <0.05, according to independent samples t test

The results show a significant and substantial reduction (by 11.7%) in prevalence of anaemia in 6-23 aged children between 2009 and 2012. The prevalence of wasting has more than doubled, from 6.3% to 16.0%, whereas stunting has reduced and underweight increased (Table 2). There is a significant increase in mean Hb level by 0.3g per dl (Table 3).

Comparison between MMN recipients and non-recipients

Table 4: Comparison of nutritional status of children aged 6-23 months, between those who received MMN and never received MMN in intervention districts[a], NNMS 2012.

Indicator	MMN received[b]			MMN not received		
	N (non-weighted)	Prevalence (%)	95% CI	N (non-weighted)	Prevalence (%)	95% CI
Stunting	507	14.1	[11.0,17.9]	616	17.7	[14.3,21.7]
Wasting	507	18.1	[14.7,22.0]	616	16.4	[13.4,20.1]
Underweight	507	19.7	[16.2,23.8]	616	21.5	[17.9,25.6]
Anaemia	490	25.2	[21.2,29.7]	586	29.7	[25.6,34.2]
Iron deficiency[c]	364	44.9	[39.2,50.8]	428	42.0	[36.5,47.6]
Iron deficiency anaemia	364	10.1*	[7.1,14.3]	428	15.7*	[12.0,20.2]
Zn deficiency[d]	316	6.8	[4.3,10.6]	376	5.7	[3.8,8.7]

[a]Badulla, Moneragala, Trincomalee, Baticaloa, Ampara, Nuwaraeliya, Hambantota, Jaffna, Kilinochchi, Mannar, Mullaitivu, and Vavuniya
[b]ever received MMN powder - 45.2% of the children 6-23 months
[c]Iron Deficiency – ferritin < 12 and CRP normal
[d]Zn deficiency – Zn <65 ug/dl morning and <57 ug/dl evening and CRP normal
*p=0.0457 for non-weighted proportions

The prevalence of anaemia is lower (25.2%) among those who have received MMN powder compared to those who haven't received it (29.7%) in the 12 intervention districts in 2012, but this difference was

statistically non-significant. However, there was a marginally significant difference in the prevalence of iron-deficiency anaemia, where the rate among recipients of MMN (10.1%) is lower than that of non-recipients (15.7%).

Table 5: Comparison of HAZ, WHZ, WAZ, and Haemoglobin levels in children aged 6-23 months, between those who ever received and never received MMN in selected districts[a], NNMS 2012.

Indicator	MMN received[b]			MMN not received		
	N (non-weighted)	Mean	CI	N (non-weighted)	Mean	CI
HAZ	507	-0.75	[-0.88, -0.61]	616	-0.85	[-0.96, -0.73]
WHZ	507	-1.04	[-1.15, -0.94]	616	-0.94	[-1.04, -0.84]
WAZ	507	-1.13	[-1.24, -1.03]	616	-1.13	[-1.23, -1.02]
Hb	490	11.65*	[11.55, 11.76]	586	11.50*	[11.39, 11.60]
Ferritin	408	62.70	[40.92, 84.47]	497	72.84	[48.51, 97.18]
Zn levels	316	81.83	[79.89, 83.77]	377	82.54	[80.64, 84.44]

[a]Badulla, Moneragala, Trincomalee, Baticaloa, Ampara, Nuwaraeliya, Hambantota, Jaffna, Kilinochchi, Mannar, Mullaitivu, and Vavuniya

[b]45.2% of children aged 6-23 months had ever received MMN powder

*p=0.0127 for non-weighted means

Mean values of the anthropometric measures were not significantly different between recipients and non recipients of MMN powder. However, it should be noted that there is a marginal and significant improvement in mean Hb by 0.15 g/dl among the recipients. There are no differences in the serum ferritin or Zn levels between recipients and non-recipients.

Table 6: Comparison of nutritional status in children aged 6-23 months, according to compliance (defined below)[b-d] in selected districts[a], NNMS 2012.

Indicator		Proper users of MMN	Improper users of MMN	Non-recipients of MMN
Stunting	Count	390	117	616
	Prevalence (%)	13.7	15.8	17.7
	CI	[10.3,18.0]	[9.7,24.5]	[14.3,21.7]
Wasting	Count	390	117	616
	Prevalence (%)	18.2	17.8	16.4
	CI	[14.4,22.7]	[11.1,27.1]	[13.4,20.1]
Underweight	Count	390	117	616
	Rate	18.9	22.9	21.5
	CI	[15.1,23.5]	[15.5,32.6]	[17.9,25.6]
Anaemia	Count	379	1111	586
	Prevalence (%)	25.9	22.3	29.7
	CI	[21.4,31.0]	[14.5,32.8]	[25.6,34.2]

Indicator		Proper users of MMN	Improper users of MMN	Non-recipients of MMN
Iron deficiency	Count	283	81	428
	Prevalence (%)	45.7	41.8	42.0
	CI	[39.2,52.3]	[29.7,54.9]	[36.5,47.6]
Iron deficiency anaemia	Count	283	81	428
	Rate	11.2	5.5	15.7
	CI	[7.7,16.0]	[1.7,16.7]	[12.0,20.2]
Zn Deficiency	Count	240	76	376
	Prevalence (%)	6.6	7.4	5.7
	CI	[3.9,11.0]	[2.8,18.6]	[3.8,8.7]

[a]all 12 intervention districts

[b] proper user of MMN' is defined as a child who has received MMN powder and taken it daily or every other day (34.7%)

[c]Improper use: received, but not given daily or every other day (10.4%)

[d]Not received: Never received (54.8%)

Of the total recipients, about 10% have not received MMN powder properly, i.e. either commenced after 12 months or given on ad-hoc basis. The sample size is not adequate to comment on the situation among those improper users.

Table 7: Comparison of HAZ, WHZ, WAZ, Haemoglobin, Ferritin, Retinol and Zinc levels in children aged 6-23 months, according to compliance (defined below)[b-d] in selected districts[a] NNMS 2012.

Indicator		Proper users of MMN	Improper users of MMN	Non-recipients of MMN
HAZ	Count	390	117	571
	Mean	-0.71	-0.88	-0.89
	CI	[-0.87, -0.55]	[-1.10, -0.66]	[-1.01, -0.77]
WHZ	Count	390	117	571
	Mean	-1.02	-1.12	-0.96
	CI	[-1.14, -0.90]	[-1.32, -0.92]	[-1.06, -0.85]
WAZ	Count	390	117	571
	Mean	-1.11	-1.25	-1.16
	CI	[-1.22, -0.99]	[-1.45, -1.04]	[-1.27, -1.05]
Hb	Count	379	111	544
	Mean	11.67	11.59	11.49
	CI	[11.55, 11.78]	[11.38, 11.81]	[11.38, 11.60]
Ferritin	Count	315	93	469
	Mean	65.80	49.71	71.34
	CI	[41.20, 90.39]	[3.30, 96.12]	[46.20, 96.49]

Indicator		Proper users of MMN	Improper users of MMN	Non-recipients of MMN
Zn level	Count	240	76	355
	Mean	82.07	80.86	82.38
	CI	[79.76, 84.38]	[77.89, 83.83]	[80.33, 84.44]

[a]all 12 intervention districts
[b] proper user of MMN' is defined as a child who has received MMN powder and taken it daily or every other day (34.7%)
[c]Improper use: received, but not given daily or every other day (10.4%)
[d]Not received: Never received (54.8%)

The mean Hb levels for proper users, improper users and non-users were 11.67, 11.59 and 11.49 g/dl respectively, with no statistically significant differences between these mean values.

Other evidence for effectiveness: Nutrition Survey in the Northern Province in Sri Lanka, 2012

A survey in the Northern Province carried out in 2012 on the nutrition status of children under 5 years old, and pregnant and lactating mothers indicated that intake of MMN supplements was associated with reduced risk of anaemia among children aged 6-23 months (SLBDC & World Bank unpublished data, 2012). MMN sachets were received by less than half the population (43.7 percent of children in the province), and the proportion of mothers who regularly fed their children was approximately half this number. The proportion of mothers who gave the entire contents of the sachet as instructed was approximately two thirds of this number. According to a multivariate regression analysis for risk factors for anaemia among children aged 6-23 months (n=956), not receiving MMN supplement was found to be significantly associated with anaemia (Adjusted OR 1.92, $P < 0.05$). There was no significant association between receipt of MMN and any of the anthropometric outcomes – stunting, wasting or underweight. Scaling up this programme, and promoting greater acceptance of MMN supplements is likely to be an effective intervention for anaemia in the short term. The main strength of this analysis is the adjustment for confounding factors using multiple regression models.

E. Sustainability of MMN supplementation programme in Sri Lanka

Policy support

The Government of Sri Lanka has clear policies in support of integrated strategies for MMN supplementation to control micronutrient deficiencies among young children in vulnerable populations. The National Nutrition Policy states: "Promote and facilitate improvement of quality of commonly consumed food items (eg.— food fortification) to ensure micronutrient supplementation for vulnerable groups" (National nutrition policy, MoH, GoSL 2010, Policy Statement 5.4.3).

The Multi-sector Action Plan for Nutrition was launched by the National Nutrition Secretariat under the directive of the National Nutrition Council, and indicated five key result areas to be achieved by 2016. One of the five areas is to reduce prevalence of aneamia by 50% from the 2012 figures. Evaluation and scale-up of the current MMN supplementation programme is listed as the action to be implemented by the Ministry of Health (MoH R3.2) (National Nutrition Council, 2013).

Strategic plans and programmatic issues

The Family Health Bureau of the MoH in collaboration with provincial health authorities and district health staff implements the MMN programme in Sri Lanka. The child nutrition unit of the Family Health Bureau is responsible for management of the programme. This include formulation of strategic plans and addressing programmatic issues at national level. The general circular issued in 2007 by the Ministry of Healthcare and Nutrition on provision of MMN for infants and young children provided the directive to initiate this programme (MOH&N, 2007 General circular 1-34-2007). The latest guideline titled "The New Schedule for Multiple Micro Nutrient (MMN) Supplementation for 6, 12 and 18 Month Age Groups," which has been effective since March 2012 provides adequate instructions for provincial and district level managers to implement the programme (FHB 2012). The revised schedule was based on WHO's new recommendations for improving infant and young child health and nutrition, and is endorsed by the Maternal and Child Nutrition Subcommittee of the Ministry of Health. Lack of country-specific evidence on the effectiveness of the MMN programme was a major constraint for making the decision to scale up the programme.

Delivery platforms

According to the current schedule, a child should receive MMN supplement on completion of 6, 12 and 18 months, daily for 60 days on each occasion. MMN powders are distributed at Child Welfare Clinics when children are brought for vaccination or at Field Weighing Posts when children are brought for weighing, by the Public Health Midwives under the supervision of Medical Officers of Health. Ideally the first 30 sachets are given when children are brought for vaccination, and the second 30 sachets either at the field weighing post or CWC - whichever is convenient to the mother. Since the country has a well-established maternal and child health programme up to the grass-roots level, the delivery of the MMN has been well integrated to this existing system. However, delays in procurement of MMN sachets and distribution from the central level to the periphery were perceived as an operational challenge faced by the programme implementers. There were some concerns regarding the lack of monitoring of the programme and poor acceptability of the MMN powder by the beneficiaries.

Cost

According the UNICEF data, cost per MMN sachet is LKR 3.76 (around US$ 0.029) and unit cost per child for each session is LKR 225 (US$ 1.72) and overall cost per child to provide MMN at 6, 12 and 18 months is LKR 675 (US$ 5.16). Since Sri Lanka has a well-established health network to distribute MMN and integrate it with the other services, indirect cost can be absorbed by these other services.

UNICEF has provided the financial support and procurement of MMN powder for the national programme. However, Government of Sri Lanka funds have to be mobilised to procure the supplies for 2015, and onwards.

Constrains

The major constrains of the implementation of the programme include:

- Non receipt of MMN supplements – more than half has not received MMN according to the NNMS 2012.
- Noncompliance with protocol – evidence showed that some do not take on regular basis, while

others do not use the entire content of the sachet.

- Delays in supply chain and distribution from the centre to the periphery.

Limitation of the present analysis include:

- Data related to the 2009 survey was not available for some districts.
- The effect of potential confounding factors on anaemia and haemoglogin were not considered in the comparisons.
- The definition "appropriate use" of MMN powder was based on the previous schedule, since the revised schedule was implemented in 2012.
- Data on Vitamin A were not available yet.

Conclusion and lessons learned

- Though the overall prevalence of Anaemia in children less than 5 years has reduced over the years in Sri Lanka, the rates among infants and young children aged 6-23 months (26.5%) is still high and above the 20% threshold level.
- Twenty districts, out of 25 reported prevalence rates above 20% within the age group 6-23 months.
- Pre- and post- comparison reveals that there is a significant reduction in the prevalence of anaemia between 2009 and 2012 in the districts where the MMN supplementation programme has been implemented.
- Receipt of MMN powder by the target population is unsatisfactory. More than half (54.8%) of the children aged 6-23 months have not received MMN supplementation powder. Only one-third (34.7%) of the target population has taken it appropriately, while 10.4% has received it, but have not taken it in the proper manner.
- The prevalence of anaemia is lower among the recipients of MMN powder than non-recipients in the intervention districts, and this difference is non-significant. However, there is a significant reduction in the mean Hb levels and iron deficiency anaemia in the recipients, in contrast to non-recipients.
- The analysis did not reveal any significant improvement in Zn levels or anthropometric indicators between recipients and non-recipients.
- In the Northern Province, despite the small proportion of children receiving the supplement in a proper manner, MMN is shown to be associated with reduced risk of being anaemic among children aged 6-23 months, after adjusting for potential confounding factors.
- There are no valid and reliable process indicators to monitor the MMN supplementation programme, which can be integrated into the routine health information system or household surveys.
- The Government of Sri Lanka has high level policy support for the MMN supplementation programme to control micronutrient deficiencies among vulnerable populations.

Recommendations

- Considering the need and benefits of the MMN supplementation (as highlighted in this review), it is recommended that the MMN supplementation programme be scaled-up to other nutritionally vulnerable districts. Prevalence of anaemia more than 20% in the age group 6-23 months can be used as the cut-off in determining the scale up of the programme.
- Since coverage of MMN is less than 50%, and compliance is low, there is a need to promote greater acceptance of multiple micronutrient powders for home fortification of foods consumed by infants and children 6–23 months of age.
- There is a need to develop valid indicators to monitor MMN supplementation and compliance, which could be built into the routine health information system and periodic household surveys.
- It would be important to streamline the procurement, supply chain and distribution process of MMN powder sachets to ensure an uninterrupted supply.

Gender, Human Rights including Child Rights

The Ethics Review Committee of the Medical Research Institute, Ministry of Health granted ethics clearance for the NFSS 2009 and NNMS 2012 which are the primary data sources for the secondary analysis. There was no exclusion due to gender, socio-cultural or economic reasons.

All the other research publications reviewed in this report stated that they have obtained ethics clearance prior to the respective studies.

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Annexure 1

COMPOSITION OF MULTIPLE MICRONUTRIENT POWDER SACHET (NET WEIGHT 1 GR) USED IN SRI LANKA

Vitamin A RE- 400 µg

Vitamin D- 5 µg

Vitamin E TE- 5 mg

Vitamin C- 30 mg

Vitamin B1- 0.5 mg

Vitamin B2- 0.5 mg

Vitamin B6- 0.5 mg

Vitamin B12- 0.9 µg

Niacin- 6 mg

Folic acid- 150 µg

Iron- 10 mg

Zinc- 4.1 mg

Copper- 0.56 mg

Selenium- 17 µg

Iodine- 90 µg