

Original Research



Implementation of the Multiple Micronutrient Supplementation Programme among infants and young children in 13 districts in Sri Lanka: a mixed method study

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Abstract

Introduction: Micronutrient deficiency has remained a problem among infants and young children in Sri Lanka despite providing multiple micronutrients (MMN) for children less than 2 years in selected districts in the country. Program implementation had not been studied since its inception.

Objectives: To assess the implementation of the MMN supplementation programme among infants and young children in thirteen districts in Sri Lanka

Methods: A mixed method study comprising a community based, cross-sectional descriptive component and a semi-structured qualitative component was conducted. We recruited 2520 children aged 7-21 months in three groups categorised according to the age of the child. Mothers of children responded to the interviewer-administered questionnaire which covered aspects of intervention fidelity, quality, participant responsiveness and dosage of the intervention. Public health midwives working in intervention districts responded to a semi-structured questionnaire on facilitators and barriers they encounter when they implement the program at the community level.

Results: Overall response rate was 97.3% (n=2452). MMN sachets were received by 920 (37.8%) children during the last two months but only 27.3% (n=665) consumed them daily. Adherence to practices for providing MMN to children by mothers was more than 90%. Mothers had a satisfactory response to all knowledge variables (n=455; 68.4%). More than 80% of the children received a public health midwife home visit in parallel to MMN supplementation (80.3%) and 79.7% (n=817) mothers who received the supplementation were satisfied with the intervention. The main barrier encountered by midwives was unavailability of stocks. They also perceived side effects to be common and thought mothers never realized the importance of supplementing micronutrients.

Conclusions: Issues in the distribution of MMN sachets resulted in poor coverage of the intervention at the community level.

Key words: micronutrients, supplementation programme, implementation, child nutrition

Introduction

Micronutrients play an essential role in maintaining the health and growth of infants and young children. Sri Lanka Demographic Health Survey in 2006/2007 reported an anaemia prevalence of 39.7% in 6-23 month age group (1). It triggered the initiation of multiple micronutrient (MMN) supplementation for children aged 6-18 months in nutritionally vulnerable districts. Home fortification and supplementation are proven interventions to reduce micronutrient deficiency in early childhood (2). It was shown that a correctly delivered intervention can reduce the anaemia prevalence by 26% in the target population (3). The initial schedule was revised in 2012 (4).

Multiple micronutrients are delivered as a powdered sachet. Public health midwives (PHM) distribute them to children at the ages of 6, 12 and 18 months. Each supplementation episode is for a period of 60 consecutive days (4). Each sachet contains 15 micronutrients including 10mg of iron, 400µg of retinol and 4.1mg of zinc (5). This intervention was introduced to 13 districts which were reported as the most vulnerable nutritionally. The districts were Jaffna, Mullaitivu, Kilinochchi, Mannar, Vavuniya, Trincomalee, Batticaloa, Ampara, Kalmunai, Badulla, Monaragala, Hambantota and Nuwara Eliya. The intervention was implemented within the existing child health programme.

A recent report revealed that the anaemia prevalence among infants and young children in eight implementation districts was reduced only by 11.7% in the past seven years (6). However, this was lower than the expected efficacy of home fortification programmes (2). The difference in outcome could be attributed to implementing difficulties of the intervention (7-9). Menon and colleagues presented the nutrition implementation framework to explain this gap between the actual and the anticipated reduction of anaemia despite an effective intervention. According to the framework, factors such as the choice of intervention, delivery, quality of the intervention, its scale and demand contribute to the outcome of the nutrition intervention (7).

In the present study, we explored the implementation related factors which would have contributed to the outcome of the nutrition intervention. The knowledge of such factors is important to develop implementation strategies and to improve the effectiveness of a large-scale programme. Further,

information on the practices and recommended behaviour of mothers helped us to identify the gaps and points of further emphasis in health communication. In the absence of routine monitoring on the implementation, the study provided information on the intervention coverage at the community level (5).

Methods

The implementation assessment took place in two stages. In the first stage, we conducted a cross-sectional descriptive study among mothers of children in the target group. In the second stage, we conducted a semi-structured qualitative analysis of the perception of PHMs working in the 13 districts on facilitators and barriers in implementation of the MMN Supplementation Programme at the community level.

Quantitative study

The study population consisted of mothers of infants and young children residing in the identified districts. Study unit was an infant or a young child aged 7-21 months. Children were selected in three groups corresponding to the age groups of MMN supplementation. Group A consisted of children aged 7-9 months. Group B was children between 13 and 15 months of age and Group C was children in 19-21 months of age.

Mothers or principal caregivers of an infant or a young child who was eligible for the first or second month of MMN supplements were interviewed for the study. Children with genetic or systemic conditions that required a special diet or on other nutrient supplements were excluded.

A two-stage cluster sampling technique was used to identify the sample. The sampling frame was the updated birth and immunization register maintained by the PHM of the area. We recruited 840 children from each age group. The sample size was calculated with estimated compliance of 50%, confidence interval at 95% and 5% absolute precision (10). In order to adjust for the homogeneity, we introduced a design effect. The maximum intra-cluster correlation coefficient for community-based cluster studies was taken as 1.1 (11). Thus, the design effect was 1.99.

A cluster was one PHM area with 10 children from each group. We required 84 clusters for the study. In

the first stage, medical officer of health (MOH) areas were selected using probability-proportionate-to-size sampling technique (12). In the second stage, PHM areas were selected as clusters by random sampling. Data collectors enumerated children from the updated birth and immunization register maintained by the area PHM. From the enumerated list, 10 children were randomly selected.

We developed indicators for four aspects of the implementation process, as defined by Dane and Schneider which was converted to variables to assess the implementation of the intervention (9). We assessed fidelity, dosage, quality, participant responsiveness of the implementation. Table 1 provides the indicator framework we developed. Adherence to practices was measured against the recommended feeding behaviour in the treatment guideline (4). We used two indicators to assess the quality of the intervention, namely the PHM home visits to encourage MMN intake (service quality) and the likelihood of mothers recommending the intervention to peers (service satisfaction) (3). The latter was also an indication of mother's fidelity.

Dosage of the intervention was described as coverage of the intervention received by the target population (13). The "intervention" was defined as feeding the child with MMN powder daily during the past 2 months. This definition was used to calculate the intervention coverage. Participant responsiveness was assessed by enquiring knowledge and perceptions of mothers on the MMN supplementation programme. Caregiver knowledge and perceptions play a key role in correct adherence to practice (3). We used these variables and definitions to generate items for the interviewer-administered questionnaire. Group of experts provided the face and consensual validity (14). Later, the questionnaire was translated to Tamil and Sinhala languages and pretested in non-selected PHM areas in Nuwara Eliya District. Further adjustments were made to improve clarity and understandability.

We recruited local women who have passed General Certificate of Education/ Advanced Level (GCE/ AL) as data collectors. They were uniformly trained in a workshop with hands-on experience on questionnaire administration. Data collectors visited households of selected children; obtained informed written consent from mothers or primary caregivers of children; and administered the questionnaire in the preferred language of the responder.

Data analysis

Data on compliance, knowledge, attitudes and practices were summarised as proportions. Epi data and Statistical Package for Social Sciences (SPSS) version 22 were used in the analysis. Associations for positive knowledge, attitudes and practices were calculated based on non-parametric tests of significance.

Qualitative study

A survey was conducted among 930 PHMs on their perceived barriers and facilitators in implementing the intervention at community level. We distributed a semi-structured questionnaire to those attached to MOH offices in all 13 districts. They responded under the themes of documentation, logistics management, storage, transport and training received to implement the programme. Responses provided to the open-ended questions were coded manually and translated to English language. We categorized these into numbers and percentages.

Results

The total response rate for the quantitative study was 97.3% (n=2452). The response rate for age categories A, B and C was 97.5% (n=819), 98.6% (n=829) and 95.7% (n=804), respectively. Mean age of the three groups of children at participation were 8.0 (SD=1.6), 14.7 (SD=1.5) and 19.4 (SD=1.9) months, respectively. For most of the children, primary caregiver during the day was the mother (n=1651; 67.3%).

Coverage of MMN Supplementation Programme (dosage of the intervention)

Coverage of the intervention was measured at two points: at distribution to the household and at delivery of the intervention (Table 2). In the total sample, only 37.8% (n=920) of children received MMN supplementation during the past two months (timely distribution coverage). However, the intervention coverage was only 27.3% in the group. The intervention was defined as a child being fed with MMN daily during the past two months (n=665; 95% CI=25.53, 29.07).

There was no significant difference across the age groups for receiving MMN powder during the first two months ($p>0.05$). In further questioning, an additional group of 279 children had received MMN sachets later than the expected time period. Therefore,

altogether 1025 children received supplementation (42.1% of the total sample). However, there was a significant difference across the age groups, with more children in group C receiving sachets than the rest at this later stage. Additionally, we looked at the lifetime coverage of the intervention among children in Group C. The intervention planned by the Family Health Bureau was to supplement children with MMN three times during the first two years of life. Out of the 804 children in the sample, only 134 children (16.7%) had received MMN at all three recommended ages. At least a single cycle of MMN was received by 266 (33.0%) of the children, while 166 children (20.6%) received two cycles of MMN. However, we assumed that all the MMNs received were consumed by children when calculating the lifetime coverage.

Adhering to practices (fidelity of the intervention)

Next, we assessed how mothers gave MMN to their children. According to guidelines, the whole sachet

should be added to a small portion of a single meal and the sachet mixed with either solid or semi-solid food. More than 90% of the mothers adhered to recommended practices on mixing the sachet with solid or semi-solid food (Table 3).

Maternal responsiveness to the intervention (participant responsiveness)

Mothers had a good knowledge of various aspects of MMN supplementation (Table 4). Among mothers receiving supplementation for their children, 40.2% (n=370) noticed a positive “change” to the health of children. However, only 21.0% (n=193) encountered an issue when feeding the supplementation to children. Common problems were children disliking the powder (n=117) and vomiting (n=61). Of mothers who fed their children with the supplement during past two months, 730 (79.3%) said they like the current consistency of the supplement, i.e. as a powder and also 483 (52.5%), said children liked to eat their meals with MMN added to them.

Table 1. Indicator framework for implementation status assessment

Aspect of the implementation assessment	Indicator
1 Fidelity	Proportion of mothers who followed the recommended practices in feeding the child with MMN powder
2 Quality	Percentage of children who received PHM home visits during the period of MMN supplementation Proportion of mothers who recommended the intervention among those who received the intervention
3 Dosage	Coverage of MMN distribution in the participant districts ('distribution coverage') Coverage of the intervention in the target population (Intervention was defined as child was fed with MMN daily during the past two months) ('intervention coverage')
4 Participant responsiveness	Proportion of mothers who had good knowledge on MMN powder Proportion of mothers with favourable attitudes towards the programme

Quality of the intervention

Ability to recommend an intervention to a peer is an important dimension in assessing the satisfaction following a health intervention. Of all the caregivers receiving MMN during the past two months, 817 (79.7%) were satisfied with the intervention.

In the community, PHM home visits could act as a facilitator for the distribution of sachets as well as for re-enforcing the practice. Of all children included in the study, the PHMs had visited 80.3% of the households of children at least once during the last three months. The proportion of children in Group A was visited (85.3%) more than the children in the other two groups.

Barriers to the programme implementation

We collected information from 959 PHMs who worked in the districts where the programme was implemented. Midwives perceived that mothers had

good knowledge of the importance of MMN (n=816; 85.1%). They also thought (n=731; 76.2%) that mothers liked to give MMN to children. At the same time, many PHMs perceived that mothers knew the correct method of giving MMN to children (n=706; 73.6%).

We enquired about major difficulties met by the staff during implementation of the programme at the field level (Table 5). There were common themes that occurred across different questions. The main challenge faced by PHMs in the supplementation programme was the unavailability of adequate stocks (43.6%). They perceived it as a barrier for stock management and distribution. They also thought some mothers needed to be informed on the feeding techniques with MMN and on its importance. For that, they suggested leaflets and other educational measures to be used as implementation strategies. However, PHMs believed that multiple side effects were faced by children while taking MMN.

Table 2. Frequencies of children who were exposed to the intervention by age groups

Variable	Group A		Group B		Group C		Total	
	No.	% *	No.	% *	No.	% *	No.	% *
Children who received MMN powder within the last 6 months	338	41.8 (38.4, 45.2)	335	40.5 (37.2, 43.9)	352	43.9 (40.5, 47.3)	1025	42.1 (40.1, 44.1)
Children who received MMN powder during the past 2 months (timely distribution coverage)	304	37.6 (34.3, 40.9)	308	37.3 (34.0, 40.6)	308	38.4 (35.0, 41.3)	920	37.8 (35.9, 39.7)
Children who were fed with MMN powder daily	226	28.0 (24.9, 31.1)	217	26.3 (23.3, 29.3)	222	27.7 (24.6, 30.8)	665	27.3 (25.5, 29.1)
Total	808		826		802		2436	

* Second row of each variable gives the 95% confidence interval of the proportion

Table 3. Frequency distribution of practices on daily MMN supplementation for children

	Age category, No. (%)			Total
	Group A	Group B	Group C	
Add the whole packet in to one meal	240 (78.9)	247 (80.1)	248 (80.5)	735 (79.8)
Mixed with solid meals	182 (59.8)	223 (72.4)	221 (71.7)	626 (68.0)
Mixed with semi-solid meals	116 (38.1)	76 (24.6)	79 (25.6)	271 (29.4)
Add the sachet immediately before feeding the child	281 (92.4)	287 (93.1)	278 (90.2)	846 (91.9)
Add to first 2 or 3 mouth full	233 (76.6)	229 (74.3)	244 (79.2)	706 (76.7)
Total*	304	308	308	920

Table 4. Characteristics of children who received the intervention (N=1025)

Characteristic	Age category, No. (%)						Total	
	Group A		Group B		Group C			
Mothers' occupation								
Employed	58	25.7	45	20.7	61	27.5	164	24.7
Housewife	155	68.6	155	71.4	136	61.3	446	67.1
Non-response	13	5.7	17	7.8	25	11.3	55	8.3
Mothers' schooling								
Up to primary education	18	7.9	10	4.6	12	5.4	40	6.0
From grade 6 to 11	88	38.9	84	38.7	82	36.9	254	38.2
Passed GCE O/L ¹	56	24.8	70	32.2	58	26.1	184	27.7
GCE A/L or higher ¹	59	26.1	49	22.5	67	30.1	175	26.3
Non-response	5	2.2	4	1.8	3	1.3	12	1.8
Mothers' knowledge²								
Good	159	70.3	135	62.2	161	72.5	455	68.4
Inadequate	64	28.3	79	36.4	60	27.0	203	30.5
Non-response	3	1.3	3	1.4	1	0.1	7	1.0
Total	226		217		222		665	

¹ General Certificate Education O/L=Ordinary Level; A/L=Advanced Level² All knowledge variables responded correctly

Table 5. Public health midwife perceptions on the barriers in the programme implementation (number of responses supporting the theme within parenthesis) (N=930)

Implementation	Barriers	Suggestions / facilitators
Stock management	Inadequate stocks (419) Not receiving at the correct time for distribution (146) Reception of expired or near expired products (53) No standard storage facilities (48)	Make adequate stocks available (339) Provide stocks at the correct time (142)
Distribution of MMN sachets to children	Unavailability of stocks to cater to the demand (332) Transport difficulties (64) Sachets were refused by mothers (48)	Distribute from the clinic (17) Adequate stocks for the demand (218) Improve taste (11)
Feeding habits of mothers	Some mothers do not have adequate knowledge (87)	Provide an accompanying leaflet (33) Educate mothers (38)
Perceptions on side effects	Vomiting as a common side effect (390) Diarrhoea is a common side effect (317)	Improve quality of the product (72) Educate by leaflets and other media (55)
PHM thoughts of the problems faced by mothers	Mothers thought MMN is not essential (141) Mothers experienced feeding difficulties while giving MMN (236)	Educate mothers (118) Provide leaflets to educate mothers (15)

Discussion

The implementation assessment was well received by the districts. Nearly 2 out of 5 eligible children in the districts received MMN supplementation in time. The expected intervention was received by only 27.3% of the target population, meaning a significant number of children were either not fed MMN or not fed daily irrespective of the fact they received the supplement. Adherence to the recommended practices was good. Mothers had good knowledge of the supplements. Their attitudes were favourable and the children liked to eat them. The quality of the programme implementation was satisfactory. As field-based imple-

menters, PHM did not receive adequate stocks to distribute. The inconsistent flow of sachets to the community level was the main barrier to successful implementation of the programme.

The study had many strengths as well as a few limitations. It covered all implementation districts of the programme and multiple dimensions of the implementation process. However, data collection was based on recall. Present study did not look into possible implementation strategies, thus further research on assessment of implementation strategies and detailed distribution mapping exercise is recommended. The present study design did not look into the programme

differentiation at the point of delivery. It would have been better if the PHMs were able to provide additional details on 'how it works in the community' so that they could be replicated in other settings.

The low intervention coverage in the present study (15.2%) was less compared to the coverage reported in a programme evaluation in 2012 (42.5%). The latter used a broad definition which was the proportion of children who ever used supplementation during their lifetime, whereas we used a comprehensive definition for the intervention as our focus was to assess the implementation process in detail (5).

In the implementation assessment, intervention fidelity is a very important aspect (8). Various studies had used different approaches to assess fidelity. A study from Peru which assessed the adherence to MMN supplementation among young children in health facilities reported a positive adherence of 24.4%. They counted empty envelopes to measure adherence and return of more than 90% of empty envelopes was considered as being compliant, which is the ideal scenario to assess adherence (15). However, the method was not feasible with the large sample size in our study. The research question in the present study was to assess implementation against the guideline issued. Simply counting empty sachets did not serve this purpose, thus we used an audit method to evaluate whether mothers followed the prescribed recommendations including the level of fidelity.

Quality is an essential component when implementing an intervention (16). Out of many possible indicators, we chose only two quality indicators. PHM home visits is a recommended practice for infants and young children while the MMN supplementation guidelines indicate that PHM home visit should be used to reinforce their behaviour. We enquired from mothers whether PHM visited the household during the months of MMN supplementation. This indicator could be used as a facilitator for the programme as well as a quality indicator. As the second indicator for programme quality, we enquired whether mothers were willing to recommend MMN for other children. It was an indirect assessment of client satisfaction (17). Both indicators were good with the present intervention.

Input from community level programme implementers is essential in shaping up the intervention. From the open-ended questionnaire, we managed to gather

information on misconceptions of PHMs such as side effects due to MMN. Although many of them believed that mothers had inadequate knowledge on how to feed MMN, it was revealed through direct questioning from mothers that they had satisfactory knowledge and knew how to use the supplementation. The perception of possible side effects of MMN and other misconceptions among PHMs should be addressed as an implementation strategy.

Conclusion and Recommendations

The low coverage of distribution was the main barrier in the programme implementation. As a result, MMN sachets did not reach household levels leading to poor coverage of the intervention. Defects in programme implementation could have contributed to low achievements of targeted nutritional outcomes of the intervention. Thus, the distribution of sachets should be streamlined and monitored at the district and national levels. Further, dimensions of implementation such as fidelity, quality of the intervention and participant responsiveness could be assessed periodically. At the community setting, implementation strategies such as reminders and leaflets to mothers starting a new schedule could be used. It could also provide details of MMN supplementation practices including the myths and misconceptions. It is time to conduct refresher training for all community level programme implementers on MMN supplementation and its goals. Regular monitoring of the implementation status is essential for implementing any community-based nutrition interventions.

Public Health Implications

- The study was conducted at the time of considering a programme scale of multiple micronutrient supplementation programme. Thus, findings are useful for the process.
- Defects in programme implementation could have contributed to low achievement of targeted nutritional outcomes of the intervention.
- Well-designed implementation strategies targeting aspects of intervention fidelity, quality, responsiveness and intervention delivery – distribution, storage, and practice up to the household level – will improve the programme coverage and the expected nutrition targets.

Author Declarations

Competing interests: Hiranya Jayawickrema and Achini Thilakaratne are involved in steering the MMN Supplementation Programme at the national level.

Ethics approval and consent to participate: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Ethics Review Committee of University of Sri Jayewardenepura. Written informed consent was obtained from all respondents who participated in the study.

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Author contributions: SD was the principal investigator of the study question and designed the study. HiJ and AT provided technical inputs from the programme perspective. RR and IG carried out the study on behalf of the Research Unit of Family Health Bureau. HeJ designed the study, analysed, and wrote the article.

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