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Acceptability and usage of universal multiple micronutrient supplementation among infants in a suburban area of Sri Lanka

E R S Bandara¹ , Y Wijekoon² and Sachith Mettananda^{1,3*}

Abstract

Background Micronutrient deficiency remains a major public health problem among children in developing countries. Universal multiple micronutrient supplementation is one strategy to prevent these deficiencies. Here, we aim to describe the usage and acceptability among infants and the knowledge and perception among mothers regarding universal micronutrient supplementation in a suburban area of Sri Lanka.

Methods This cross-sectional study was conducted in Kurunegala district of Sri Lanka from June to August 2022. Infants aged between 9 and 12 months attending the well-baby clinics of four Medical Officers of Health areas were recruited after obtaining informed written consent from their mothers. Data were collected using an interviewer-administered questionnaire that included questions on maternal knowledge, perceptions, and practices regarding micronutrient supplementation. Data were analysed using the chi-square test. Ethical approval was obtained from the Sri Lanka College of Paediatricians.

Results A total of 395 mothers participated. The mean age of the infants of participating mothers was 10.3 ± 1.1 months. All infants had received micronutrient supplements; however, only 58% used the recommended dosage (7 sachets per week), and 37% used < 4 sachets per week. A majority (56.5%) stated that food acceptability was lower when micronutrient supplements were mixed. 76% and 44% mothers, respectively, reported that the addition of micronutrient supplements introduced a bad taste and smell to the food. All mothers were aware of the daily dosage and the method of mixing micronutrient supplements with food. However, only 55% were aware of the recommended duration of supplementation. A majority (95%) of mothers perceived micronutrient supplements as beneficial, and 55% found the micronutrient preparations easy to use. A significantly higher proportion of mothers in skilled or professional employments had good knowledge of multiple micronutrient supplementation than mothers who were unemployed or in unskilled occupations.

Conclusions The supply of micronutrient supplements has been regular in the Kurunegala district during the study period. However, acceptability was low, at least partly due to changes in food taste and smell after adding micronutrient supplements. The low acceptance is likely due to factors intrinsic to the micronutrient preparations, which need to be rectified in the future.

*Correspondence:
Sachith Mettananda
sachith.mettananda@kln.ac.lk

Full list of author information is available at the end of the article



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Keywords Micronutrient supplementation, Micronutrient deficiency, Nutritional intervention

Introduction

Micronutrients, such as vitamins, minerals, and trace elements, are important for the growth and physiological functions of children [1–3]. Micronutrient deficiency remains a major public health problem in many developing countries, including Sri Lanka [4, 5]. These deficiencies are highly prevalent among children under five years old due to rapid growth and poor dietary practices [6, 7]. Infants are among the highest risk groups for micronutrient deficiency due to their high metabolic and growth requirements [8].

A number of interventions are implemented in various countries to combat micronutrient deficiencies [9, 10]. One such example is food fortification with micronutrients [11]. To mitigate micronutrient deficiencies in early childhood, the World Health Organisation introduced the supplementation of infant weaning foods with multiple micronutrients (MMN). These supplements are provided as sachets containing various vitamins and minerals [12].

The universal MMN supplementation programme in Sri Lanka commenced in 2007 in selected nutritionally vulnerable districts and was expanded countrywide in 2012 [13]. MMN sachets are distributed to all infants in Sri Lanka by public health midwives at well-baby and immunisation clinics. As per the current recommendation, a two-month supply of MMN (a total of 60 sachets, to be given as one sachet per day) is provided free to all infants aged 6, 12, and 18 months attending these clinics.

MMN is given to parents as a powder to fortify children's meals [14]. Mothers are advised to add the whole sachet to semisolid or solid food and feed within 10 to 15 min after mixing. Since MMN are not water soluble, they should not be mixed with water or other fluids [15]. The current preparation used in Sri Lanka contains 15 micronutrients that include vitamin A 400 µg, 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, vitamin C 30 mg, vitamin D 5 µg, vitamin E 5 mg, iron 10 mg, zinc 4.1 mg, copper 0.56 mg, selenium 17 µg and iodine 90 µg [13].

Sri Lanka, a low- to middle-income country in South Asia, is divided into nine provinces and 25 administrative districts. The North Western Province of Sri Lanka is an average province in terms of size, population, development, and urbanisation. It represents the average level of development and lifestyle in Sri Lanka. Although a handful of studies conducted in the past have evaluated the acceptability of MMN across different parts of Sri Lanka, none have been conducted in the North Western Province [13–16].

Despite the implementation of the MMN supplementation programme in Sri Lanka for over a decade, micronutrient deficiencies, especially iron and vitamin D deficiencies, remain a significant health problem in Sri Lanka [5, 7, 17]. The prevalence of iron deficiency, iron deficiency anaemia (IDA), vitamin D deficiency and zinc deficiency was 5.4%, 1.8%, 26.2% and 15.3% respectively. Northwestern province reported a similar prevalence of IDA (1.7%) and a slightly higher rate of zinc deficiency (16.7%) compared to national values [18]. Most studies evaluating the efficacy of MMN supplementation were conducted over a decade ago, and there is sparse evidence on knowledge and practices related to MMN in recent years [19, 20]. Thus, there is a strong need for well-designed studies evaluating the current status of the MMN supplementation programme in Sri Lanka. This study aims to describe the usage and acceptability among infants and the perception and knowledge among mothers regarding universal MMN supplementation in a suburban district in the North Western Province of Sri Lanka.

Methods

We conducted a cross-sectional study in the Kurunegala district of Sri Lanka between 01 June and 31 August 2022. Kurunegala is a suburban district in the North Western Province, approximately 100 km from the capital Colombo. Kurunegala district was selected for the study as it is one of the three largest districts by area and population, and is a typical suburban district of Sri Lanka.

Infants aged 9 to 12 months attending the immunisation and well-baby clinics in the Kurunegala district during the study period were eligible to participate in the study. Four of 26 Medical Officer of Health (MOH) areas in the Kurunegala district were randomly selected for the study. Each MOH area was assigned a number from 1 to 26, and four MOH areas (Wariyapola, Kobeigane, Nikaweratiya, and Yapahuwa) were selected using a random number table. All eligible infants attending immunisation and well-baby clinics of the selected MOH areas during the study period were recruited after obtaining informed written consent from mothers.

The sample size was calculated using the standard formula for descriptive studies ' $N = Z^2 \times P(100-P)/d^2$ ' for critical value at 95% confidence interval (Z) of 1.96 and desired precision (d) of 5% [21]. An estimated prevalence (P) of 0.5 was considered to maximise the sample size. The calculated minimum sample size was 384. Mothers of infants who were not given MMN due to medical contraindications (e.g., premature infants who were on

vitamin supplements) or having neurological and feeding difficulties were excluded.

An interviewer-administered questionnaire was used to collect data (Supplementary File 1). The questionnaire included questions to gather information on the sociodemographic background of the study participants and on maternal knowledge, perceptions, and practices regarding MMN supplementation. Usage and acceptability of MMN supplementation were assessed over the 2 months of its administration. Maternal knowledge of MMN was assessed using a score based on the number of correct answers given for five questions on MMN. The score ranged from 0 to 5, with higher scores indicating greater knowledge. The maternal knowledge was then categorised into 'Good' (Score of ≥ 4 out of 5) and 'Poor' (Score of ≤ 3 out of 5) based on the score.

Data were analysed using IBM SPSS Statistics 22.0. Quantitative variables were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages. The chi-square test was used to determine the statistical significance of dichotomised variables, and the statistical significance was set at $p < 0.05$.

Ethical clearance was obtained from the Ethics Review Committee of the Sri Lanka College of Paediatricians

(Ref: SLCP/ERC/2022/17). Administrative clearance was obtained from the Regional Director of Health Services of the Kurunegala District and selected Medical Officers of Health before the commencement of the study.

Results

A total of 395 mothers participated in the study. The mean age of the infants of the participating mothers was 10.3 ± 1.1 months. The majority ($n = 200$, 50.6%) of infants were male, and the mean body weight was 7.3 ± 0.9 kg. The sociodemographic characteristics of mothers in the study sample are given in Table 1.

Usage and acceptability of MMN supplements

All 395 (100%) infants received MMN supplement sachets. A majority ($n = 379$, 95.9%) received them according to the guideline at six months, whereas the others received them at seven months. The well-baby clinic was where MMN sachets were obtained by 350 (88.6%) infants, and 45 (11.4%) obtained MMN sachets at the field weighing post. Almost all (99%) mothers received the full requirement of MMN sachets for the two months. However, only 58% used the full requirement while 37.2% used less than four sachets a week instead of the recommended seven sachets a week (Table 2). None of the mothers reported showing empty MMN sachets to the public health midwife during the next visit, as required by the MMN supplementation programme.

All mothers claimed that their children had consumed at least a small amount of MMN; however, on average, only 55% consumed sachets fully. A majority of mothers (56.5%) stated that the acceptability of food by the child was lower when MMN was mixed (Table 2).

Observation of changes in food due to MMN supplementation

We next evaluated the maternal observation of changes in food after mixing MMN. Many mothers observed no significant change in the colour or texture of food after mixing MMN (Table 3). However, 299 (75.7%) claimed that MMN added a bad taste to food, and 175 (44.3%) reported that it added a bad smell to food even within the first 10–15 min, which is the recommended period of consuming food after mixing MMN.

Maternal knowledge of MMN supplementation

All mothers were aware of the recommended daily dosage and the method of mixing MMN with food (Table 4). However, only 55% were aware of the recommended duration of supplementation.

Maternal perception regarding MMN supplementation

We examined the maternal perception regarding MMN supplementation. A majority (95%) of mothers perceived

Table 1 – Sociodemographic characteristics of mothers in the study sample

	Frequency (<i>n</i> = 395)	Per- cent- age
Age		
< 20 years	2	0.5
21–25 years	107	27.1
26–30 years	120	30.4
31–35 years	134	33.9
36–40 years	30	7.6
> 40 years	2	0.6
Level of education		
Up to GCE O/L	209	52.9
Between GCE O/L and GCE A/L	152	38.5
Beyond GCE A/L	34	8.6
Occupation		
Unemployed / Housewife	265	67.1
Unskilled occupation	66	16.7
Skilled occupation (e.g., clerk, skilled factory worker)	33	8.4
Lower professional (e.g., teacher, nurse)	31	7.8
Higher professional (e.g., doctor, engineer)	0	0
Number of children		
1	184	46.6
2	175	44.3
3	23	5.8
4	11	2.8
5	2	0.5

Table 2 – Usage and acceptability of MMN supplements

	Frequency (n = 395)	Per- cent- age
Number of MMN sachets received (for 2 months)		
60 sachets / 2 boxes (full requirement)	392	99.2
30 sachets / 1 box (half requirement)	3	0.8
Number of MMN sachets used (over 2 months)		
60 sachets (full requirement)	229	58.0
30–59 sachets (50–100% requirement)	107	27.1
< 30 sachets (< 50% requirement)	59	14.9
Frequency of using MMN sachets		
7 per week (daily)	75	19.0
5–6 per week	173	43.8
3–4 per week	136	34.4
1–2 per week	11	2.8
Method of administration of MMN sachets		
Mixed with rice	342	86.6
Mixed with fruits (smashed fruits)	23	5.8
Mixed with other food	30	7.6
Did the mother show empty MMN sachets to the clinic		
Yes	0	0
No	395	100.0
Had the child consumed any amount of MMN		
Yes	395	100.0
No	0	0
Average amount consumed (per day)		
Full sachet	219	55.4
Half of the sachet	158	40.0
Less than half of the sachet	18	4.6
Acceptance of MMN mixed food		
Acceptance of food is better than before	3	0.8
Acceptance of food is the same as before	169	42.8
Acceptance of food is less than before	223	56.5

Table 3 – Changes in the food observed after mixing MMN

Parameter	Good [n, (%)]	No change [n, (%)]	Bad [n, (%)]
Colour	94 (23.8)	277 (70.1)	24 (6.1)
Taste	0 (0.0)	96 (24.3)	299 (75.7)
Smell	0 (0.0)	220 (55.7)	175 (44.3)
Texture	0 (0.0)	395 (100.0)	0 (0.0)

MMN as beneficial (Table 5). However, 34% said they did not receive adequate information about their use.

Determinants of good maternal knowledge

Finally, we examined the determinants of good maternal knowledge of MMN supplementation. Of all participants, 336 (85.0%) had a good knowledge of MMN. A significantly higher proportion of mothers employed as skilled workers or professionals had a good knowledge of MMN supplementation than mothers who were unemployed or in unskilled occupations (Table 6).

Table 4 – Maternal knowledge of MMN supplementation

Maternal knowledge of MMN supplementation	Mothers who answered correctly	
	Number (n = 395)	Per- centage
Correctly knew the recommended daily dosage	395	100
Correctly knew the recommended frequency	379	95.9
Correctly knew the recommended duration of supplementation	219	55.4
Correctly knew the recommended method of mixing with food	395	100
Correctly knew what to do when a dosage is missed	381	96.5

Table 5 – Maternal perception of MMN supplementation

Questions regarding maternal perception of MMN supplementation	Yes n (%)	No n (%)
Do you think that MMN is beneficial?	376 (95.2)	19 (4.8)
Is MMN preparation easy to use?	219 (55.4)	176 (44.5)
Are you aware of why it is given to your child?	276 (69.9)	119 (30.1)
Do you have worries regarding the side effects of MMN?	36 (9.1)	359 (90.9)
Are there any delays in the provision of MMN?	12 (3.0)	383 (97.0)
Did you receive adequate information regarding MMN?	261 (66.1)	134 (33.9)

Table 6 – Determinants of good maternal knowledge on MMN supplementation

Demographic factor	Number (%) with good knowledge	Number (%) with poor knowledge	Chi- square value	p- value
Maternal age				
≤ 25 years (N = 109)	83 (76.2%)	26 (23.8%)	1.60	0.20
> 25 years (N = 286)	253 (88.5%)	33 (11.5%)		
Maternal education level				
≤ O/L (N = 209)	173 (82.8%)	36 (17.2%)	1.82	0.17
> O/L (N = 186)	163 (87.6%)	23 (12.4%)		
Maternal occupation				
Unemployed/unskilled (N = 331)	274 (82.8%)	57 (17.2%)	8.36	< 0.01
Skilled/professional (N = 64)	62 (96.9%)	2 (3.1%)		

Discussion and conclusions

In this study, we described maternal knowledge, perceptions, and practices regarding MMN supplementation in a suburban area of Sri Lanka. The study was conducted nearly one and a half decades after introducing the MMN supplementation program and highlights the important limitations and perceptions towards the program by mothers of infants aged 9–12 months. The study is

particularly important, as most studies of MMN acceptability have been conducted several years earlier, at the inception of the programme in Sri Lanka [15]. Recent events, such as the COVID-19 pandemic and economic recession, have significantly impacted nutrition and health prevention programmes in Sri Lanka. Therefore, recent data, especially post-COVID pandemic data on the subject, are extremely useful.

One important finding of the study is that MMN delivery to the target population is 100%. This contrasts with earlier studies that reported erratic delivery of MMN sachets and issues arising from the COVID-19 pandemic [15, 22]. This highlights that the public health system in Sri Lanka has been back on track after the COVID-19 pandemic and has been performing well amid the economic recession in 2022.

Despite being received by all mothers, our results show that the use of MMN sachets has been considerably low. Only 58% had used MMN fully, and nearly 15% had used less than half the amount, indicating a high wastage. This is consistent with the findings of a recent survey conducted in an urban district of Sri Lanka, which reported a MMN adherence rate of 72.5% (defined as the percentage of children who consumed $\geq 80\%$ of the prescribed sachets per month) [14]. Although the guidelines recommend showing the empty sachets to the public health midwife when receiving the next supply of MMN to ensure compliance, our results show that it is not being practised in the field. The most likely reason is that mothers are not keeping the empty sachets or bringing them to the clinic due to practical difficulties or noncompliance. This could lead to unnecessary waste of resources and funds allocated to public health services in Sri Lanka, a low- and middle-income country facing severe economic constraints.

The study revealed that most mothers (86.6%) mixed MMN in rice. This was not surprising as rice is the staple food in Sri Lanka, and most Sri Lankans eat rice for all three main meals. This is true for infants as well, and rice is the recommended food even at the commencement of weaning. Also, the Sri Lankan guidelines recommend mixing MMN in rice.

One primary reason for the lower utilisation is the poor acceptability of MMN by infants. Only 55% of mothers said their children regularly take the full sachet daily with meals, and 56% reported that food acceptability has decreased when mixed with MMN. The change in intake could partly be due to changes in the taste and smell of food after adding MMN. Similar changes in food intake have been reported in other studies done using formal sensory analysis in Sri Lanka and other developing countries [14, 23]. This highlights an important point where the food intake of infants could be compromised by the addition of MMN, thus leading to growth problems,

especially underweight. Ironically, it could increase the risk of macronutrient deficiencies and malnutrition following an intervention tailored to address micronutrient deficiencies. Developing MMN preparations that do not alter the taste or smell of food, or introducing different modes of micronutrient supplementation, would be necessary to overcome these shortcomings.

Our study revealed that maternal knowledge of MMN supplementation is satisfactory, with most mothers able to answer key questions about MMN. Good knowledge was associated with skilled or professional occupations. Similar findings have been reported in studies from other developing countries, where higher social class mothers reported greater knowledge of public health interventions [9, 22, 24, 25]. Overall, these data indicate that the poor acceptance of MMN supplementation is unlikely to be due to inadequate knowledge of MMN supplementation but is likely related to factors intrinsic to the MMN preparations used.

Our study has many strengths. We comprehensively evaluated the usage, acceptability, perceptions and knowledge of MMN supplementation among mothers of infants in a suburban area of Sri Lanka. The findings of this study can be used to improve the MMN supplementation programme in Sri Lanka and other developing countries. Our study is the first study on MMN supplementation in Sri Lanka after the COVID-19 pandemic. Hence, it provides useful insights into the efficiency of nutritional supplementation programmes in the post-pandemic era. One important limitation of our study is that it was confined to one suburban area of Sri Lanka. We believe our study will be a catalyst for conducting similar studies in other parts of Sri Lanka and in other developing countries to gain a broader understanding of the MMN supplementation programme.

In conclusion, our study highlights that the delivery of MMN supplements has been regular post-COVID-19 pandemic in the Kurunegala district of Sri Lanka. However, the acceptability of MMN supplements has been low, possibly due to changes in food taste and smell after adding MMN. More importantly, food intake has been low after mixing MMN in most infants. The reasons for low acceptance need to be rectified to achieve the desired results of the MMN supplementation programme in the future.

Abbreviations

MMN Multiple micronutrients
IDA Iron deficiency anaemia

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40795-025-01235-7>.

Supplementary Material 1.

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Not applicable.

Authors' contributions

ERSB and SM were involved in the literature review, writing the project proposal and obtaining ethical approval. ERSB and YW were involved in data collection. ERSB, YW and SM are involved in data entry and analysis. ERSB, YW and SM wrote the manuscript. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request..

Declarations

Ethics approval and consent to participate

All research procedures were carried out adhering to the Declaration of Helsinki. Ethical approval was obtained from the Ethical Review Committee of the Sri Lanka College of Paediatricians (Ref: SLCP/ERC/2022/17). Informed written consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Colombo North Teaching Hospital, Ragama, Sri Lanka

²Medical officer of Health office, Maho, Sri Lanka

³Department of Paediatrics, Faculty of Medicine, University of Kelaniya, Thalagolla Road, Ragama, Kelaniya 11010, Sri Lanka

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