

Multiple micronutrient supplementation programme of Sri Lanka: Does it deliver the goods? Experience from the Central Province - A preliminary study

Saliya Kumara Samarathunga¹, *Gihani Udeshika Vidanapathirana², Sanath Thushara Kudagammna²

Sri Lanka Journal of Child Health, 2021; 50(3): 393-400

Abstract

Introduction: Micronutrient deficiencies have been identified as a global health problem with higher prevalence rates in developing countries. In Sri Lanka, a multiple micronutrient (MMN) supplementation programme was started in 2007 in the most nutritionally vulnerable districts and extended to the whole country in 2012. Though effectiveness is established, success of the MMN programme depends on the compliance of caregiver towards programme guidelines.

Objectives: To assess the knowledge, attitude, and usage of MMN supplement among mothers and to identify problems of the MMN supplementation programme in order to optimize effectiveness.

Method: Mothers of 9-18 month old children, living in Yatinuwara Medical Officer of Health division and attending the Child Health Clinics, were selected for the study. Data were collected in 16 Child Health Clinics using a pre-tested interviewer administered questionnaire to assess knowledge, attitude and usage level of the MMN supplement. Data were analysed using SPSS version 20.

Results: Of 400 mothers included in the study 374 (93.5%) have received the supplements. Of them, 262 (65.5%), 236 (59%) and 338 (84.5%) were not aware that iron, calcium and zinc were included in the MMN supplement respectively. Though 240 (60%) mothers wanted to give the supplement to their baby, only 94 (25.13%) could give the supplement continuously as advised.

Conclusions: Acceptance rate of the MMN supplement was highly satisfactory. Though more than half the mothers wanted to give the supplement to their baby, only a quarter could give it continuously. Improving awareness of the mothers about the MMN supplement and the programme is of paramount importance to make this nutritional programme a success.

DOI: <http://doi.org/10.4038/sljch.v50i3.9686>

(Key words: Mothers, knowledge, attitude, practice. MMN supplement, Sri Lanka)

Introduction

Micronutrient deficiency (MND) is a global health problem with a high prevalence rate in developing countries¹. Micronutrients include vitamins, minerals and trace elements, which, though needed in minute amounts, are vital for normal growth, development and physiological functioning². MND causes many problems in brain development, immunity and higher functions of children³. Deficiency of iron, vitamin A and iodine together affect around 30% of the world's population⁴. It is estimated that more than 2 billion have anaemia, around 2 billion have iodine deficiency and around 250 million preschool children have vitamin A deficiency⁵. It is estimated that 7.3% of global burden diseases are caused by MND⁶. Iron-deficiency anaemia (IDA), vitamin A deficiency and iodine deficiency result in 25 million, 18 million and 2.5 million deaths respectively⁷. MND also has implications on the economic development and productivity of the country⁸.

Management of MND with micro-nutrient supplementation using oral multiple micro-nutrition sachets has recently gained popularity in many parts of the world⁹. The Health Ministry of Sri Lanka implemented this programme of multiple micronutrients (MMN) supplementation in 2007 in the most nutritionally vulnerable districts such as Nuwara Eliya, Badulla, Moneragala, and Trincomalee⁹. This was expanded to the other districts in Sri Lanka in 2012⁹. A survey conducted in the Northern Province in 2012 on the nutritional status of under-five year old children and pregnant and lactating mothers showed that MMN supplementation was associated with a decreased risk of anaemia in 6-23 month old children⁹. It

¹Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, ²Department of Paediatrics, Faculty of Medicine, University of Peradeniya

*Correspondence: udeshigihani@gmail.com

 <https://orcid.org/0000-0002-2808-6198>

(Received on 22 June 2020; Accepted after revision on 21 August 2020)

The authors declare that there are no conflicts of interest

Personal funding was used for the project.

Open Access Article published under the Creative

Commons Attribution CC-BY  License

concluded that stimulating greater acceptance of MMN supplements will probably be an effective short term intervention for anaemia⁹.

According to the programme guidelines⁹, MMN are given in a sachet as a powder to fortify the child's meal at home. The current preparation used in Sri Lanka contains 15 micronutrients (vitamin A 400µg, vitamin D 5µg, vitamin E 5mg, vitamin C 30mg, vitamin B1 0.5mg, vitamin B2 0.5mg, vitamin B6 0.5mg, vitamin B12 0.9µg, niacin 6mg, folic acid 150µg, iron 10mg, zinc 4.1mg, copper 0.56mg, selenium 17µg and iodine 90µg)⁹. Lack of nationally representative data has hindered determination of MND prevalence in different Sri Lankan population groups¹⁰. However, available data suggest higher prevalences of iron, zinc, calcium, folate, and vitamin A deficiencies¹¹. Furthermore, higher prevalence of micronutrient deficiency has been identified in the Central Province¹. In the present schedule, each child should receive one sachet of the MMN supplement daily for 60 days after the completion of 6, 12 and 18 months⁹. Though the effectiveness of the MMN programme is established, success depends on many other factors including compliance of the caregivers towards the programme guidelines, which in turn will depend on a proper understanding of the contents of the MMN, the underlying purpose of the programme and the expected side effect profile etc.

Objectives

To assess the knowledge, attitude, and usage of MMN supplement among mothers of 9–18 month old children in Yatinuwara Medical Officer of Health (MOH) area and identify common problems of the MMN supplementation programme in order to optimize its effectiveness.

Method

A descriptive, cross-sectional study was carried out from January to June 2018 in the Yatinuwara MOH area. Data were collected in 16 randomly selected child health clinics covering the 38 public health midwife areas. Sample was designed to represent urban, rural, and estate sectors according to their representation in the population. Mothers having babies with severe swallowing problems, organic dysfunctions, severe growth faltering or twins were excluded from the sample. According to Yamane's formula¹² [$n = \frac{N}{1 + N(e)^2}$, n =sample size, N =population size, e =level of precision 0.05], final sample size was 400 including additional 10% for non-respondents.

An interviewer-administered questionnaire was used to collect data. It was pre-tested in the same

population and validated accordingly. Questionnaire comprised 4 sections; demographic characteristics, knowledge of mothers, attitude of mothers and usage of MMN by mothers. There were 7 main questions to assess knowledge and usage level of MMN supplement among mothers. Another 6 questions evaluated the attitude of the mothers about this supplement. Each question was allocated 5 marks and the total was calculated out of 100. The knowledge, attitude, usage levels were assessed categorically as 0-49 = low, 50-74 = moderate, 75-100 = high, based on the percentage obtained. Descriptive statistics were used to describe the socio demographic variables.

Ethical issues: Ethical clearance for the research was taken from the Ethical Review Committee of Faculty of Allied Health Sciences, University of Peradeniya (AHS/ERC/2017/027). Informed written consent was obtained from the mothers for the study.

Statistical analysis: Data were analysed by using Statistical Package for Social Science, version 20. $p < 0.01$ was considered significant. Pearson correlation coefficient was used to examine the relationship between study variables.

Results

A total of 400 mothers was included in the study. The demographic data of the mothers and the age and gender distribution of the children are shown in Table 1.

When considering the demographic data, the majority was from the rural sector and was Sinhalese. Twenty six mothers had not received the MMN supplement due to various reasons. However, these 26 participants have been included for the statistical analysis of knowledge and the attitudes of the mothers.

Knowledge of the mothers regarding MMN supplement

Of the 400 mothers 94% had heard about MMN supplement and 87.8% were aware that it contained multiple micro-nutrients essential for the growth and development of their babies. Whilst 89% of the mothers had received information about the supplement from the midwife of the area, 11% had obtained information from a hospital nurse. However, only 25% of the mothers were aware about micro-nutrient deficiency. When asked about the ingredients of the MMN supplement, 81.8% mothers knew that vitamins are ingredients but 34.5% and 65.5% mothers respectively were not aware that calcium and iron are ingredients (Table 2).

Table 1: Demographic data of mothers and age and gender distribution of child (n=400)

Category	Frequency (%)
<i>Mother's age (years):</i> ≤ 20	08 (02.0)
21-25	31 (07.8)
26-30	143 (35.8)
31-35	121 (30.2)
36-40	87 (21.8)
41-45	09 (02.2)
>45	01 (0.2)
<i>Mother's ethnicity:</i> Sinhalese	318 (79.5)
Muslim	62 (15.5)
Tamil	20 (05.0)
<i>Mother's educational level:</i> No proper school education	05 (01.2)
Incomplete primary education	09 (02.2)
Passed up to Grade 5	05 (01.2)
Passed up to Grade 8	64 (16.0)
Passed GCE Ordinary Level	169 (42.2)
Passed GCE Advanced Level	114 (28.5)
Completed higher education	34 (08.5)
<i>Residential area:</i> Urban	81 (20.3)
Rural	301 (75.3)
Estate	18 (04.5)
<i>Age of child (months)</i> 09	119 (29.7)
12	132 (33.0)
18	149 (37.3)
<i>Gender of child:</i> Male	227 (56.8)
Female	173 (43.2)

Table 2: Evaluation of mother's knowledge about MMN supplement (n=400)

Question	Answers	Frequency (%)
1. According to your knowledge what is MMN supplement?	A supplement to increase baby's appetite	16 (04.0)
	A supplement with multiple micronutrients essential for growth and development	351 (87.8)
	An additional food item for the child	06 (01.5)
	Other	01 (0.3)
	Did not receive MMN supplement	26 (06.5)
2. Have you heard about the illnesses prevented by this supplement?	Yes	272 (68.0)
	No	102 (25.5)
	Did not receive MMN supplement	26 (06.5)
3. Do you know about micro-nutrient deficiency	Yes	100 (25.0)
	No	274 (68.5)
	Did not receive MMN supplement	26 (06.5)
4. Do you know that vitamins are components of MMN supplement?	Yes	327 (81.8)
	No	47 (11.8)
	Did not receive MMN supplement	26 (06.5)
5. How did you learn about MMN supplement?	From the midwife of the area	356 (89.0)
	From a hospital nurse	11 (02.8)
	From a friend	01 (0.3)
	Other	06 (01.5)
	Did not receive MMN supplement	26 (06.5)
6. Of the following, what are the ingredients of the MMN supplement?		
(i) Zinc	Yes	36 (09.0)
	No	338 (84.5)
	Did not receive MMN supplement	26 (06.5)
(ii) Calcium	Yes	138 (34.5)
	No	236 (59.0)
	Did not receive MMN supplement	26 (06.5)
(iii) Iron	Yes	112 (28.0)
	No	262 (65.5)
	Did not receive MMN supplement	26 (06.5)
Are you aware that any one of iodine, copper, folic acid or selenium are components of MMN supplement	Yes	112 (28.0)
	No	262 (65.5)
	Did not receive MMN supplement	26 (06.5)

Attitude of mothers regarding MMN supplement

When we evaluated the commitment of mothers towards giving MMN to the child, 240 (60%) mothers agreed to give this supplement to their baby without hesitation. However, 73 (18%) mothers refused to give the MMN supplement to the baby. When the underlying reasons for giving MMN were examined, 196 (79.7%) mothers had given MMN supplement to the child knowing its real benefits, whilst 46 (18.7%) had given it following the advice of the midwife. Absence of a

disease in the child (11.9%), proper maintenance of child's weight (26.9%), prescription of other vitamin supplement by doctors (5.3%) and difficulty to feed the child after adding the supplement (20.4%) were the main reasons quoted by mothers for not giving the supplements to the child. Mothers have identified certain side effects of MMN supplement. Decreasing appetite has been observed by 126 (31.5%) mothers, nausea and vomiting by 34 (8.5%) mothers and constipation by 40 (10%) mothers (Table 3).

Table 3: Evaluation of mother's attitude about the MMN supplement

Question	Answers	Frequency (%)
1. What is the reason for giving MMN supplement to your child?	Because the midwife of the area told to give that to the child	46 (18.7)
	Because the supplement contains a lot of vitamins and minerals essential for growth and development of the child	196 (79.7)
	Because the supplement is given free by the government	02 (0.8)
	Other	02 (0.8)
	Total	246*(100.0)
2. What is the reason for not to giving this supplement to your child?	Because the child does not have a disease	18 (11.8)
	Because child's weight is in proper level or more	41 (27.0)
	Because it is difficult to feed the baby after adding the supplement	31 (20.4)
	Because we are giving all the vitamin supplements according to the doctor's advice	08 (05.3)
	Other	28 (18.4)
	Did not receive MMN supplement	26 (17.1)
	Total	152**(100.0)
3. Do you think that there are side effects of this MMN supplement?	Agree	77 (19.25)
	Neutral	48 (12.0)
	Unsure	89 (22.3)
	Disagree	160 (40.0)
	Did not receive MMN supplement	26 (06.5)
	Total	400 (100.0)
4. Did you observe decreasing appetite as a side effect?	Yes	126 (31.5)
	No	248 (62.0)
	Did not receive MMN supplement	26 (06.5)
	Total	400 (100.0)
5. Did you observe nausea, vomiting as a side effect?	Yes	34 (08.5)
	No	340 (85.0)
	Did not receive MMN supplement	26 (06.5)
	Total	400 (100.0)
6. Did you observe constipation as a side effect?	Yes	40 (10.0)
	No	334 (83.5)
	Did not receive MMN supplement	26 (06.5)
	Total	400 (100.0)

*Only the mothers who gave the MMN supplement to their children have been considered.

**Only the mothers who did not give the MMN supplement to their children have been considered.

Usage of MMN supplement

When considering usage of the MMN supplement from the 374 mothers who received it, only 222 (59.4%) could give the full content of the supplement to the child while 152 (40.6%) could not give the whole quota of the supplement at once. In addition to that, 81.3% of mothers have given the supplement with the first portion of the diet as suggested in the guidelines and 36 (9.6%) have given the supplement with the middle portion of the

diet. Only 115 (60.2%) out of the 374 respondents have given this supplement continuously for 60 days according to the guidelines while 99 (26.5%) of them were unable to give the supplement at least for 15 days. Among the 374 respondents, 103 (27.5%) children have completely refused the food when MMN supplement is added and 190 (50.8%) had slight refusal. Hence, 207 (55.4%) mothers have attempted to give supplement with child's favourite food item to improve uptake. (Table 4)

Table 4: Evaluation of the usage level and the pattern of the MMN supplement

Question	Answers	Frequency (%)
1. How many days did you give this supplement continuously?	Less than 15 days	99 (26.5)
	More than 15 and less than 30 day	50 (13.4)
	30 days	49 (13.1)
	More than 30 and less than 60 days	61 (16.3)
	60 days	94 (25.1)
	More than 60 days	21 (05.6)
	Total	374***(100.0)
2. With what type of meal did you give this supplement to the child?	With liquid diet	10 (02.7)
	With semi solid diet	265 (70.9)
	With solid diet	99 (26.5)
	Total	374 (100.0)
3. How long did it take to give the meal to the child after mixing with the supplement?	Within 5 minutes	335 (89.6)
	Within 30 minutes	27 (07.2)
	Did not concentrate on the time	12 (03.2)
	Total	374 (100.0)
4. Were you able to give the full content of the supplement?	Yes	222 (59.4)
	No	152 (40.6)
	Total	374 (100.0)
5. Which method did you follow to give the supplement to the baby?	Giving the supplement with the first portion of diet	304 (81.3)
	Giving the supplement with the middle portion of diet	36 (09.6)
	Giving the supplement with the last portion of diet	34 (09.1)
	Total	374 (100.0)
6. How did the child express his/her compliance for the meal mixed with the supplement	Child did not refuse the food	81 (21.7)
	Child slightly refused the food	190 (50.8)
	Child completely refuses the food	103 (27.5)
	Total	374 (100.0)
7. Did you try to mix the supplement with child's favourite meal to improve compliance?	Yes	207 (55.4)
	No	167 (44.7)
	Total	374 (100.0)

*** Mothers who received the MMN supplement have been considered for the analysis.

When gauging the overall success of the programme according to the total score obtained, 142 (35.5%) mothers have obtained marks

categorized as low. Only 76 (19%) mothers have obtained marks categorized as high (Figure 1).

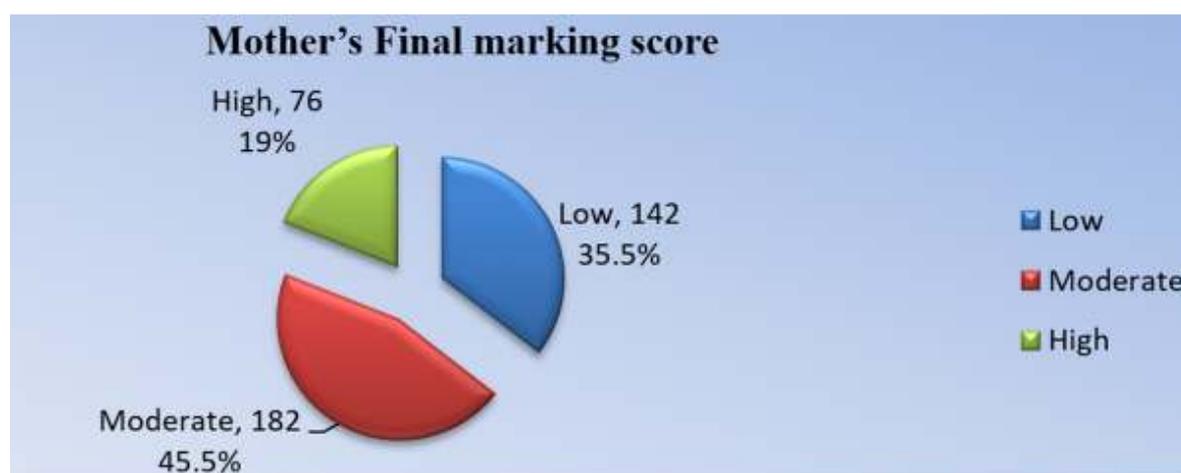


Figure 1: Mother's final total score

To test for an association between mother's highest level of education and mother's total score, Spearman correlation was used. The estimated value of $p = 0.000 (<0.01)$ indicates an association between mother's total score and mother's highest

level of education. Interestingly, an association was noted between the residential area (urban, rural or estate) and mother's total score $p = 0.003 (<0.01)$ but not mother's age.

Discussion

Iron, vitamin A and iodine deficiency are the major micronutrient problems in Sri Lanka and other micronutrient deficiencies observed in Sri Lankan children include zinc, calcium and folate⁹. During childhood, these micronutrient deficiencies may cause anaemia, restrict growth, hinder motor and cognitive development and affect immune function¹². Strategies implemented worldwide to overcome micronutrient deficiencies in children, include health education, dietary modification, provision of nutritious food, micronutrient supplementation and fortification¹³.

A systematic review of 17 random controlled trials from developing countries estimated that micronutrient supplements reduced IDA by 57% and retinol deficiency by 21%¹³. A recent meta-analysis on micronutrient supplementation and fortification among children under-five in low and middle income countries revealed a significant impact of this MMN supplementation on reducing micronutrient deficiencies in infants¹⁴.

MMN supplementation for infants and young children¹⁵ commenced in Sri Lanka supported by the UNICEF in 2007. They are distributed through child welfare clinics conducted by the Family Health Workers supervised by the Medical Officers of Health. A study to determine the efficacy of MMN supplementation in Sri Lanka between 2009 and 2012 in the districts where the programme was implemented showed that MMN supplementation has significantly decreased the prevalence of anaemia by 34%, IDA by 57% and retinol deficiency by 21%⁹. Although this study examined the efficacy of targeted fortification interventions, no assessment was done regarding knowledge and attitudes of mothers about MMN supplement. The present study aimed at filling the gap between available evidence on the efficacy of the MMN supplementation programme and the knowledge, attitude of mothers about MMN and its usage. Further, it highlights the current status of MMN supplementation programme.

A collaborative research carried out by the Ministry of Health in 2012 revealed that 54.8% of the 6-23 month old children in the 12 intervention districts had not received MMN powder⁹. Another survey in the Northern Province in 2012 indicated that MMN sachets were received by only 43.7% of children in the province⁹. In our study, only 26 (6.5%) participants had not received the supplement, a markedly low percentage compared to previous studies.

Concerning knowledge among the study population regarding the MMN supplement, 94% of participants had heard about it, 88% knew that it

contains micronutrients essential for the child's growth and 68% knew that it can help prevent micronutrient deficiencies such as underweight, stunting and anaemia. No other study has assessed the knowledge about the micronutrient deficiencies prevented by the MMN supplement.

In our study 19.3% mothers observed that the supplement has side effects including decreased appetite, nausea, vomiting and constipation. Another study recognized that MMN supplement was associated with a significant increase in diarrhoea as a side effect⁹. However, one should be cautious when interpreting this because side effect is a consequence of long term exposure to several variables.

Regarding usage level of MMN supplement, 60% of the 374 respondents have given this supplement according to the guidelines while 38% of the recipients have not given the supplement to their children properly. Senerath U, *et al*⁹ revealed that only 34.7% of 6-23 month old children received MMN powder, either daily or every other day. Thus 65.3% of the children did not receive the MMN supplement according to guidelines although the supplement was available in their household. The survey conducted in Northern Province has found that the proportion of mothers who regularly gave MMN supplements to their children was 21.9%. The proportion of mothers who gave the entire contents of the sachet as instructed was approximately two thirds of the target population⁹.

When considering the overall knowledge, attitude and usage level about the MMN supplement according to the score they have achieved, only 19% of the mothers had a satisfactory response while 45.5% had a neutral response which needs improvement. However, 51.9% mothers of the total sample agreed with the statement that "this MMN supplement should definitely be given to the baby" which is a positive trend. Others had a negative attitude towards it. In this study knowledge about MMN supplements among urban households was significantly higher than among rural households. This difference is likely to be due to lack of access to information among villagers. This is an area that needs attention. Currently, mothers have a wide source of nutrition information and child health clinic continues to be an avenue through which majority of mothers gain nutrition knowledge. Other sources of information which can provide a comprehensive knowledge need to be made available for the majority of the people.

There were many problems related to the MMN programme that have been identified during the study. The usage level of MMN has come down due to influence of negative attitudes on practice.

Most of them believed that the growth of their elder children has been sufficient without the MMN supplement and thus were not convinced of its said benefits. A considerable number of mothers have recognized that the child refuses the food after mixing the MMN supplement, thus having a concern of it having a negative effect on the growth and development. Education status plays an important role in avoiding misleading attitudes from the caregivers. There is a paramount importance to increase awareness regarding the importance of this supplement for the children among mothers.

Knowledge regarding MMN supplement among mothers was not optimal within the study population which has been translated in to suboptimum compliance towards the usage. Improved delivery of knowledge, helping to overcome the practical issues faced in administration of MMN supplements to children and a mechanism to monitor the programme are needed for the improvement of the efficiency of the programme.

Conclusions

Acceptance rate of the MMN supplement was highly satisfactory. Though more than half the mothers wanted to give the supplement to their baby, only a quarter could give it continuously. Improving awareness of the mothers about the MMN supplement and the programme is of paramount importance to make this nutritional programme a success.

References

1. Abeywickrama HM, Koyama Y, Uchiyama M, Shimizu U, Iwasa Y, Yamada E, *et al.* Micronutrient status in Sri Lanka: a review. *Nutrients* 2018; **10**(11): 1583.
<https://doi.org/10.3390/nu10111583>
PMid: 30373264 PMCID: PMC6265675
2. Al-Fartusie FS, Mohssan SN. Essential trace elements and their vital roles in human body. *Indian Journal of Advances in Chemical Science* 2017; **5**(3): 127-36.
3. Kapil U, Bhavna A. Adverse effects of poor micronutrient status during childhood and adolescence. *Nutrition Reviews* 2002; **60**(5): 84-90.
<https://doi.org/10.1301/00296640260130803>
PMid: 12035866
4. Akhtar S, Ahmed A, Randhawa MA, Atukorala S, Arlappa N, Ismail T, *et al.* Prevalence of vitamin A deficiency in South Asia: causes, outcomes, and possible remedies. *Journal of Health, Population, and Nutrition* 2013; **31**(4): 413.
<https://doi.org/10.3329/jhpn.v31i4.19975>
PMid: 24592582 PMCID: PMC3905635
5. Ahmed N. Dietary practices and nutritional status of pre-school children of Sivasagar, Assam. *International Journal of Computer Applications in Engineering Sciences* 2012; **2**(3):2231
6. Bhan MK, Sommerfelt H, Strand T. Micronutrient deficiency in children. *British Journal of Nutrition* 2001; **85**(2):199-203.
<https://doi.org/10.1079/BJN2001315>
PMid: 11509111
7. Jalambo MO, Naser IA, Sharif R, Karim NA. Knowledge, attitude and practices of iron deficient and iron deficient anaemic adolescents in the Gaza Strip, Palestine. *Asian Journal of Clinical Nutrition* 2017; **9**(1):51-6.
<https://doi.org/10.3923/ajcn.2017.51.56>
8. Darnton-Hill I, Webb P, Harvey PW, Hunt JM, Dalmiya N, Chopra M, *et al.* Micronutrient deficiencies and gender: social and economic costs. *American Journal of Clinical Nutrition* 2005; **81**(5): 1198S205.
<https://doi.org/10.1093/ajcn/81.5.1198>
PMid: 15883452
9. Senarath U, Jayatissa R, Siriwardena MI, 2014. Evaluation of Multiple Micronutrient Supplementation Programme in Sri Lanka 2009-2012. Available from: mri.gov.lk/wpcontent/uploads/2019/10/MultipleMicronutrient-report.pdf
10. Peiris TD, Wijesinghe DG. Nutritional status of under 5 year-old children and its relationship with maternal nutrition knowledge in Weeraketiya DS division of Sri Lanka. *Tropical Agricultural Research* 2010; **21**(4): 330-9.
<https://doi.org/10.4038/tar.v21i4.3309>
11. Family Health Bureau, Ministry of Health (2014) 'Guideline on Establishing Nutrition Clinics in Medical Officer of Health areas', Available from:

- http://fhb.health.gov.lk/web/index.php?option=com_phocadownload&view=category&id=12&Itemid=149&lang=en
12. Israel GD. Determining sample size. 2017
 13. Bailey RL, West Jr KP, Black RE. The epidemiology of global micronutrient deficiencies. *Annals of Nutrition and Metabolism* 2015; **66**(2):22-33.
<https://doi.org/10.1159/000371618>
PMid: 26045325
 14. Salam RA, MacPhail C, Das JK, Bhutta ZA. Effectiveness of Micronutrient Powders (MNP) in women and children. *BMC Public Health* 2013; **13**(3):S22.
<https://doi.org/10.1186/1471-2458-13-S3-S22>
PMid: 24564207 PMCID: PMC3847468
 15. Tam E, Keats EC, Rind F, Das JK. Micronutrient supplementation and fortification interventions on health and development outcomes among children under-five in low-and middle-income countries: A systematic review and meta-analysis. *Nutrients* 2020; **12**(2):289.
<https://doi.org/10.3390/nu12020289>
PMid: 31973225 PMCID: PMC7071447
 16. World Health Organization. Guideline: use of multiple micronutrient powders for home fortification of foods consumed by infants and children 6-23 months of age. 2011