Journal of the Postgraduate Institute of Medicine 2017; 4 (1):E44 1- 12
http://doi.org/10.4038/jpgim.8119

Original Article

Effectiveness of a homemade supplementary food in the management of severe acute malnutrition in 2-5 year old children in the Kopay MOH area

Josephine Thirumagal Sivashankar[1], Neil Thalagala[2]

[1]University of Jaffna, [2]Family Health Bureau, Sri Lanka

Keywords: moderate acute malnutrition (MAM), homemade supplementary food (HMSF), children under five years, weight gain

Abstract

Introduction

Reducing wasting in children under 5 years is a challenge in Sri Lanka. Management strategy of moderate acute malnutrition (MAM) is to have target food supplementation as energy dense snacks.

Objectives

To assess the feasibility, acceptability and effectiveness, of a homemade supplementary food (HMSF) in the management of moderate acute malnutrition in 2-5 year old children.

Methods

A community based quasi experimental study was carried out from October to December 2014. The test population (n=275) were 2-5 year old children with MAM from Kopay MOH area. The control group (n=285) were children of similar age with MAM from Uduvil, Nallur area. HMSF consisted of a pre-packed cereal mixture (50g), with sugar (20g) and scraped coconut (20g) added at home (calorie content =500 kcal/90g), as a daily snack to the intervention group. Baseline weight and monthly weight gain was measured using standard calibrated weighing scales. Compliance and any acute illnesses were monitored weekly by calling or visiting households. Average weight gain of both groups was analysed using independent sample t–test. The acceptability and feasibility of the HMSF was assessed by focus group discussions with the PHMs and the mothers.

Results:

Mean age of test group and control group was 42.6 months and 43.1 months respectively. There was no difference in the baseline weight of the two groups (95%CI -0.059-0.416: p=0.14). The mean weight gain in the test group and control group after 3 months was 688.5g (SD=437gm) and 583g (SD=461gm) respectively (p=0.006). The mean gain in length in the test group and control group after 3 months was 1.5cm (SD=0.93cm) and 1.66cm (SD 1.3 cm) (p=0.234) respectively.

Conclusions and Recommendations:

This HMSF was effective, feasible and acceptable in improving weight in MAM children under the age of five years.

Corresponding Author: Josephine Thirumagal Sivashankar E-mail: <thiru_siva@hotmail.com> http://orcid.org/0000-0002-5854-8867
Received: October 2017, Accepted revised version June 2017, Published July 2017
Competing Interests: Authors have declared that no competing interests exist

Introduction

Undernutrition is defined as insufficient provision of energy and nutrients (such as good quality proteins with an adequate balance of essential amino acids, vitamins and minerals) and an inability to meet the requirements necessary to ensure growth, maintenance and specific functions of the body [1]. Acute undernutrition in children has two main manifestations; (i) macronutrient deficiency presenting as protein energy malnutrition (ii) micronutrient deficiencies, commonly iron, iodine, vitamin A and zinc deficiency. Acute undernutrition affects weight in a short period of time and is referred to as wasting. If uncorrected, wasting leads to chronic undernutrition, and affects length/height, which is referred to as stunting. Moderate acute undernutrition in children is defined as a weight for height below -2SD (standard deviation) but above -3SD of the median of the WHO child growth standard.

Global data in 2011 indicates that 101 million children were underweight, 165 million stunted and 43 million overweight or obese in the under-five population [2]. Acute malnutrition affects 10% of the world's children under five [3]. Prevention of early childhood undernutrition leads to important health, education and economic benefits [4].

The two main strategies to overcome this situation are poverty alleviation and targeted nutritional intervention [3]. Home based management of acute malnutrition using food supplementation, with or without behaviour change, has improved the nutritional status of under five children in Cambodian urban poor communities and in migrant communities in the Dominican Republic and Haiti [5,6]. Social and economic policies of the country should be changed, in addition to health and nutrition intervention, in order to achieve a sustainable reduction in undernutrition [7].

Evaluation of 'Thriposha', a supplementary food used in Sri Lanka, indicated that only 50% of the target group received the supplement. Ineffective distribution and sharing at household level further reduced its effectiveness [8,9]. The World Food Programme distributed fortified corn soya blend to 33 identified MOH areas in Sri Lanka. However, baseline and post intervention surveys showed no direct nutritional improvement and there was family sharing at the household level [10].

The national rates of underweight, stunting and wasting of the under-five age group for 2012 were 17.2%, 11.4% and 14.0% respectively. The rates for Nuwara Eliya District for the same year were 21.5%, 18.8% and 22% respectively compared to 11.5%, 5.1%, and 9.6% for Gampaha District. This shows the wide disparity existing between different districts [11,12].

The nutritional status of under five children in Sri Lanka is intractable and static for the last 3 decades, although National as well as District level programmes were redesigned as part of Millennium Development Goal 1(MDG1) which is reduction of under-five undernutrition by 40% [13, 14]. This study aims to assess the feasibility, acceptability and effectiveness of a homemade supplementary food (HMSF) to improve weight gain in children between the ages two to five years with moderate acute malnutrition (MAM).

Methods

A community based, quasi experimental study was designed. Study population and matched control population was recruited from Medical Officer of Health (MOH) regions in the Jaffna District of Sri Lanka (Figure 1).

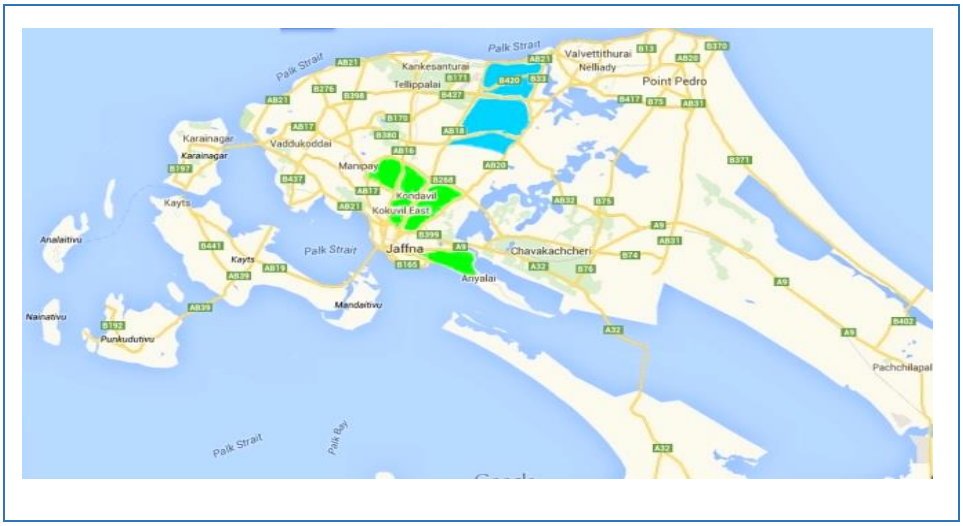

Figure 1. Map showing the geographical study areas
Green: Uduvil and Nallur MOH area – Control group Blue : Kopay MOH area – Intervention group.

The study was conducted from 1st October to 31st December 2014 in three MOH areas of the Jaffna District where the nutrition rehabilitation programme for undernourished children conducted by the State / World Bank (funded by JICA) was not carried out, in order to prevent contamination.

Inclusion criteria for the intervention group were children aged 2-5 years residing in the Kopay MoH area under the care of area Public Health Midwives (PHMs) for at least 6 months with weight for height <-2SD and ≥-3SD from the median of the World Health Organization (WHO) Child Growth Standards.

Inclusion criteria for the control group were children aged 2-5 years residing in the Uduvil and Nallur MoH areas, under the care of area PHMs for at least 6 months with weight for height <-2SD and ≥-3SD from the median of the World Health Organization (WHO) Child Growth Standards. Children with acute or chronic illnesses were excluded.

Sample size was calculated expecting a 50% cure rate among the intervention group using the following formula [15].

$$N = \frac{[\sqrt[z_\alpha]{P(1-P)(\frac{1}{q1}+\frac{1}{q2})} + \sqrt[z_\beta]{P_1(1-P_1)(\frac{1}{q_1}) + P_2(1-P_2)(\frac{1}{q_2})}]2}{(P_1 - P_2)2}$$

N= total number of subjects in each group
q_1=q_2 1:1 equal proportions of both intervention and non-intervention groups
P_1= Proportion of MAM children -14.3% (Jaffna District nutrition month data 2013)
P_2= Proportion of MAM children after 3 months of intervention- 7%

Z_{α} = The standard normal deviation for alpha taken as 1.96
Z_{β} = The standard normal deviation for beta taken as 90%

Calculated sample size for each group was 263 children. After adding 10% for possible non-responders the final sample size was 289 in each arm. A consecutive sample of children who fulfilled the inclusion criteria were recruited for the intervention arm and the control arm of the study.

Apart from the socio-demographic details, a pre-tested, interviewer administered questionnaire was administered by trained PHMs to collect 24 hour dietary recall data, food diversity, personal hygienic practices and nutrition related knowledge of mothers.

Table 1. Composition of homemade supplementary food

Composition of HMSF	Weight
Parboiled rice	200g
Green gram	100g
Bengal gram	100g
Black gram	100g
Sesame seeds	50g
Groundnut	50g
Total	600g
Carbohydrate	59.5%
Protein	17.85%
Fat	14.50%
calorie density	440Kcal/ 100g

The homemade supplementary food mixture (Table 1) was prepared under the direct supervision of the MOH and PHI in two grinding mills close to the MOH office to ensure correct composition and cleanliness.

The roasted and ground cereal mixture was packed and labelled. The product was distributed to the mothers of the intervention group bi-weekly. This HMSF has been approved by the Industrial Technology Institute of Sri Lanka (World Bank project I.D. 121571).

The quantity of each serving of HMSF was determined after conducting a pilot test of the snack among preschool children (n=36) in Kopay MOH area. They were given a snack made of ground cereal mixture (100g) with added sugar (40g=2 teaspoons) and scraped coconut (40g= 2 teaspoons). The food bag was weighed after the meal and the mean weight consumed was calculated (mean=90g, 95%C.I 88-90).

Therefore, the intervention group was given 50g ground cereal mixture(measured and pre-packed) mixed with 20g (2 teaspoons) sugar and 20g(2 teaspoons) scraped coconut (total = 90g).

The HMSF was given to the children at home as a daily snack, either in the morning or evening for 12 consecutive weeks. Compliance was assessed weekly by contacting the mothers via telephone and/or through home visits by PHMs. Any acute illnesses were documented. Height was measured at the start and end of the study period according to the Nutrition Rehabilitation Programme guidelines [16]. Weight of children were measured at baseline and monthly thereafter by the PHMs (Figure 2).

The independent sample t-test was applied for comparison of the 2 groups using SPSS 21. Compliance with the supplementary food and the type and duration of acute illnesses were analysed using mean differences.

Ethical approval for the study was obtained from the Ethics Review Committee of Faculty of Medicine, University of Colombo and administrative clearance was obtained from the Regional Director of Health Services, Jaffna.

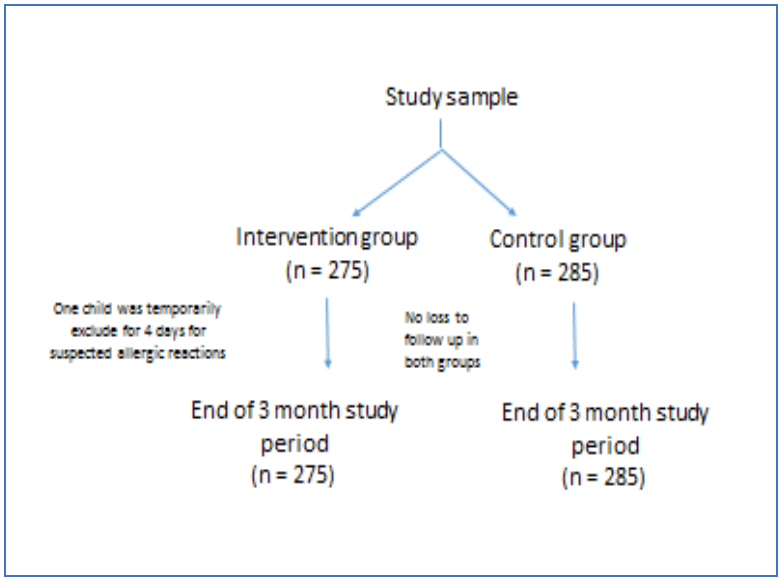

Figure 2: Flow chart of study implementation

There was no loss to follow up in both groups during the 3 months study period.

Results

All children were of Tamil ethnic origin and 92% of them were Hindus while others were Christians. The respondents were the mothers of the children.

There was no significant difference in the socio-demographic characteristics of the intervention and control groups such as age, sex, birth weight, birth order and household wealth index.

Socioeconomic characteristics were also similar in both groups, except for the father's occupational status (Table 2). There was no significant difference between the two groups in dietary diversity (p= 0.713).

Table 2 Distribution of socio demographic characteristics of the study groups

Characteristics & Subjects	Intervention group (N=275)	Control group (N=285)	Significance
Age group	**N (%)**	**N (%)**	
23 - 36 Months	85 (30.9)	71 (24.9)	x^2=5.744 df=3 P=0.125
37 - 48 Months	86 (31.3)	116 (40.7)	
49 - 60 Months	89 (32.4)	83 (29.1)	
Sex			
Male	149(54.2)	132(46.3)	x^2=4.283 df=2 P=0.117
Female	126(45.8)	152(53.3)	
Birth Weight (g)			
<2500	71 (25.8)	61 (21.4)	
>2500 & above	204 (74.2)	224 (78.6)	
Education level of the father			
No schooling	9 (1.6)	11 (2)	x^2=1.345 df=5 p=0.93
Year 1-5	20 (3.6)	23(4.1)	
Year 6-10	108(19.3)	99 (17.7)	
GCE (O/L)	92 (16.4)	103 (18.4)	
GCE (A/L)	36 (6.4)	38 (6.8)	
Tertiary education	10 (1.8)	11(2)	
Education level of the mother			
No schooling	3 (0.5)	5 (0.9)	x^2=4.180 df=5 p=0.524
Year 1-5	11 (2)	18 (3.2)	
Year 6-10	86 (15.4)	98 (17.5)	
GCE (O/L)	117 (20.9)	108 (19.3)	
GCE (A/L)	47 (8.4)	41 (7.3)	
Tertiary education	11 (2)	15 (2.7)	
Occupation of the father			
Legislators, senior officials, managers	3 (0.5)	7 (1.3)	x^2=25.990 df=10 p=0.004
Professionals	1 (0.2)	13 (2.3)	
Technicians and associate professionals	5 (0.9)	7 (1.3)	
Clerks	1 (0.2)	2(0.4)	
Service workers, shop and market sales workers	43 (7.7)	54 (90.6)	
Skilled agricultural and fishery workers	15 (2.7)	17(3)	
Craft and related trade workers	16 (2.9)	18(3.2)	
Plant and machine operators and assemblers	18 (3.2)	14 (2.5)	
Elementary occupations	98 (17.5)	95 (17)	
Armed forces and others	75 (13.4)	51 (9.1)	
unemployed	0 (0)	7 (1.3)	
Occupation of the Mother			
Legislators, senior officials, managers	3 (0.5)	3 (0.5)	x^2 =6.247 df=9 p=0.715
Professionals	5 (0.9)	5 (0.9)	
Technicians and associate professionals	1 (0.2)	4 (0.7)	
Clerks	2 (0.4)	2 (0.4)	
Service workers, shop and market sales workers	7 (1.3)	11 (2)	
Skilled agricultural and fishery workers	1 (0.2)	0 (0)	
Craft and related trade workers	2 (0.4)	2 (0.4)	
Plant and machine operators and assemblers	1 (0.2)	2 (0.4)	
Elementary occupations	0 (0)	0 (0)	
Armed forces and others	8 (1.4)	3 (0.5)	
Unemployed (House Wife)	245 (43.8)	253 (45.2)	

Table 3 shows the average group weights of the intervention and control children at the beginning and at the end of each month during study period.

Table 3: Comparison of weight gain in the intervention and control groups

Average weight of children (Kg)	Intervention group(SD) (n=275)	Control group (SD) (n=285)	Significance	Mean Difference (95% CI)
Before intervention	11.20 (1.48)	11.02 (1.37)	t=1.48 df =558 p=0.14	0.18 (-0.06-0.42)
At the end of 1 month	11.53 (1.51)	11.20 (1.39)	t=2.74 df =558 p=0.006	0.34 (0.10-0.58)
At the end of 2 months	11.69 (1.49)	11.41 (1.42)	t=2.333 df =558 p=0.020	0.29 (0.05-0.53)
At the end of 3 months	11.89 (1.50)	11.60 (1.41)	t=2.294 df =558 p=0.022	0.28 (0.04-0.53)

At the beginning of the study the mean weight of the intervention group and the control group was 11.2kg and 11.02kg respectively. At the end of the first month, the mean weight of the intervention group and control group was 11.53kg and 11.20kg respectively showing a significant difference between the two groups (p=0.006). The difference in weight gain continued to be evident at the end of the second and third months (p=0.020, p-0.022 respectively).

Figure 3 illustrates the difference in rate of weight gain between the intervention and control groups.

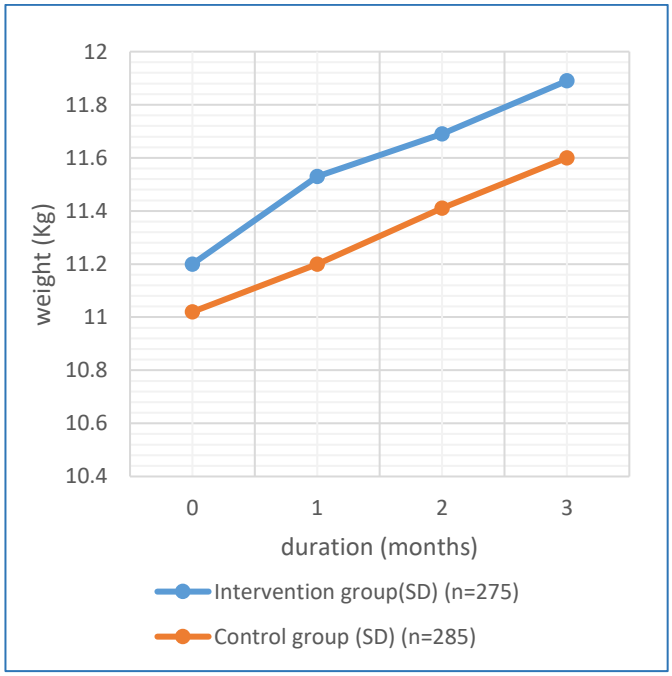

Figure 3: comparison of rate of weight gain

The rate of weight gain was higher in the intervention group at the end of the first month following the introduction of HMSF.

Table 4 shows the pattern of adherence to the home made supplementary food in the intervention group.

Table 4: Adherence to Homemade supplementary food

Type of compliance with the HMSF	Frequency	N (%)
Use of HMSF for main meal	Always Most of the time Some days Never	(6)2.2% (13)4.7% (67)24.4% (189)68.7%
Added scraped coconut/sugar to HMSF	scraped coconut only Sugar only both sugar & scraped coconut	(1)0.4% (5)1.8% (269)97.8%
Child ate supplementary food during illness as usual	Yes No	(153)55.6% (122)44.4%
Stopped supplementary food due to intolerance	No	(275)100.0%
Child couldn't eat due to supply issues	No	(275)100.0%

HMSF was not the main meal in nearly 70% of children. Ninety-eight percent of children consumed added sugar and scraped coconut. There were no supply issues and no one stopped the HMSF due to intolerance. One child was temporarily asked to stop HMSF for 4 days due to a suspected allergic reaction by a paediatrician, but later it was reintroduced under the paediatrician's observation

Table 5 shows the effect of other factors that may influence weight gain during the study period.

Table 5: Comparison of positive and negative confounders of weight gain in the control group

Confounders	Mean (days)	Mean Difference. (95% CI) P value
'Thriposha' vs. weight gain	40 (range 13-77)	0.03754 (-0.0687-0.14379) p=0.488
Respiratory infection vs. weight gain	4 (3 days)	0.07823 (0.0024-0.15405) p=0.043
Fever days vs. weight gain	2 days (3 days)	0.0425 (-0.03568-0.12068) p=0.286
Diarrhoea vs. weight gain	3 days (1 day)	0.05610 (-0.03339-0.14559) p=0.219

Concurrent respiratory infection had a significant effect (p= 0.043) on weight gain. Eating "Thriposha" and diarrhoeal or febrile illness did not have a significant influence on the children's weight gain during the study period.

The children ate more than half of the given HMSF on average for 60 days (median = 80 days, S.D=32 days) which indicates good compliance with the HMSF.

The focus group discussions with the PHMs and the mothers indicated very high acceptability as well as sustainability of this intervention and household sharing was minimal.

Table 6 shows the proportion of children who achieved normal nutritional status in both groups during the study period according to WHO height and weight chart.

Table 6: Proportion of children who achieved normal nutritional status (>-2SD)

	Intervention group	Control group	Significance
normal nutritional status	158 (57.45)	110 (38.60)	95% C.I (10.8 – 27.1) P<0.001
improved nutritional status	113(41.10)	159(55.79)	
acute severe malnutrition	4(1.45)	16(5.61)	p<0.01

*Intervention group (n=275) **Control group (n=285)

There was no significant difference in the average weight of the two groups of MAM children at the beginning of the study (mean difference=0.1785, 95%CI -0.059-0.416: p=0.14). At the end of 3 months about 57.5% of the intervention group achieved normal nutritional status compared to 38.6% of the control group (p<0.001, 95%CI 10.8-27.01). Four (1.45%) children in the intervention group deteriorated and developed acute severe malnutrition compared to 16(5.61%) in the control group (p<0.01). The net positive effect on nutritional status is 98.55%.

The mean difference in height (+0.1154) between the two groups was not significant during the short study period of three months (95CI 0.30 – 0.74, p=0.234).

Discussion

Reducing the number of underweight children among the under-five population has been a challenge for Sri Lanka for decades, despite several government nutrition intervention programmes such as 'Thriposha", "super cereal plus", "poshana malla", and "Samurdhi" for underprivileged populations.

In this study, more than half (57.5%) the children in the intervention group achieved normal nutritional status (weight for height Z-score ≥ -1) at the end of 3 months. Nutrition supplementation for 159 children under four years with MAM in urban, poor Cambodia showed that 55% (n= 87) achieved normal nutritional status after 14 weeks, which is similar to data from our study [3]. The same study indicated a 5.6% rate of case fatality during the 14 weeks [3], whereas no case fatalities occurred in the current study. Migrant workers' children under the age of 18 years (of whom 59% were <5 years) in the Dominican Republic were given food supplementation for 1 year from 2005 – 2006 which led to a reduction in acute malnutrition from 40% to 23% (p=0.001) and chronic

malnutrition from 33% to 18% (p=0.003), probably due to the longer duration of food supplementation [9].

A cluster randomized trial in Haiti comparing behaviour change communication for 6- 23 month children and a recuperative model for children aged 6 – 60 months showed that children who were continuously exposed to the behaviour change model showed improvement in their weight for age and weight for height after 3 years (p<0.001)[10].

The views of the PHMs pertaining to the newly introduced homemade supplementary food suggest that, though the availability, accessibility, affordability, feasibility were high in this HMSF, motivation of the parents, firm encouragement and monitoring / supervision for non-sharing at household level by the health staff were vital for the success of the programme.

Conclusions

This study shows that homemade supplementary food is effective in improving weight gain in children aged 2-5 years with moderate acute malnutrition. The programme was feasible and acceptable. The results of this study indicate a long awaited solution to a major challenge faced by Sri Lanka, besides a way to achieve MDG target 1. This solution comes from within the community and is based on an evidence based intervention teamed with health promotion. Preparation of HMSF and feeding the child requires a positive and permanent behaviour change on the part of the principal caretaker. This intervention is likely to bring about a positive impact, when facilitated and monitored by the primary health care team more specifically the PHMs, as the ownership of the nutritional activity is with the community.

Acknowledgements

My sincere thanks to the Regional Director of Health Services, Jaffna, Dr A. Ketheeswaran, Medical Officers of Health Dr T. Jeyaseelan, DrJeyakumaran and Drthiripuvanasundari and their entire public health care team for the support extended to us during the study in their areas.

The findings of this study was presented at the Biennial Academic sessions of the Postgraduate Institute of Medicine, University of Colombo in July 2016 [17].

References

1. De Onis M, Monteiro C, Akré J, Clugston G. The worldwide magnitude of protein-energy malnutrition: an overview from the WHO Global Database on Child Growth. Bulletin of the World health Organization. 1993 Nov 1;71(6):703-12.
2. Martins VJ, Toledo Florêncio TM, Grillo LP, Do Carmo P Franco M, Martins PA, Clemente AP, Santos CD, Vieira MD, Sawaya AL. Long-lasting effects of undernutrition. International journal of environmental research and public health. 2011 May 26; 8(6):1817-46. https://doi.org/10.3390/ijerph8061817

3. Harris S, Jack S. Home-based treatment of acute malnutrition in Cambodian urban poor communities. Food and nutrition bulletin. 2011 Dec; 32(4):333-9. https://doi.org/10.1177/156482651103200404
4. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, Webb P, Lartey A, Black RE, Group TL, Maternal and Child Nutrition Study Group. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? The Lancet. 2013 Aug 9; 382(9890):452-77. https://doi.org/10.1016/S0140-6736(13)60996-4
5. Parikh K, Marein-Efron G, Huang S, O'Hare G, Finalle R, Shah SS. Nutritional status of children after a food-supplementation program integrated with routine health care through mobile clinics in migrant communities in the Dominican Republic. The American journal of tropical medicine and hygiene. 2010 Sep 1; 83(3):559-64. https://doi.org/10.4269/ajtmh.2010.09-0485
6. Ruel MT, Menon P, Habicht JP, Loechl C, Bergeron G, Pelto G, Arimond M, Maluccio J, Michaud L, Hankebo B. Age-based preventive targeting of food assistance and behaviour change and communication for reduction of childhood undernutrition in Haiti: a cluster randomised trial. The Lancet. 2008 Feb 22; 371(9612):588-95.https://doi.org/10.1016/S0140-6736(08)60271-8
7. Bryce J, Coitinho D, Darnton-Hill I, Pelletier D, Pinstrup-Andersen P. Maternal and child undernutrition: effective action at national level. The Lancet. 2008; 371(9611):510-526. https://doi.org/10.1016/S0140-6736(07)61694-8
8. Jayatissa, R., Gunathilaka, M. M., & Fernando, D. N. (2013). Aneamia among children aged 6-59 months and nutritional status of children and adults-National nutrition and micronutrient survey (Vol. Part 1). Colombo.
9. Jayatissa R, Fernando D. Landscape Analysis to Accelerate Actions to Reduce Maternal and Child Undernutrition Sri Lanka. http://www.who.int/nutrition/landscape_analysis/SriLankaLandscapeAnalysisCountryAssessmentReport.pdf?ua=1 (accessed 29.05.2017)
10. Hettiarachchi M, Liyanage C. Efficacy of 'Thriposha' supplementation in improving the micronutrient status of preschool children. Ceylon Medical Journal. 2010 Sep 27;55(3) https://doi.org/10.4038/cmj.v55i3.2292
11. Family Health Bureau. (2011). Annual report on Family Health Colombo: Ministry of Health.
12. Ministry of Health. (2012). Annual Health Bulletin. Colombo. http://www.health.gov.lk/enWeb/publication/AHB-2012/Annual%20Health%20Bulletin%20-%202012.pdf (accessed 29.05.2017.)
13. Central Bank of Sri Lanka. (2013). Economic and social statistics of Sri Lanka (Vol. XXXV). Colombo: Central Bank of Sri Lanka. http://www.cbsl.gov.lk/pics_n_docs/10_pub/_docs/statistics/other/econ_&_ss_2013_e.pdf (Accessed 29.05.2017.)
14. Department of Census and Statistics. (2005). Selected Millenium Development Goals (MDG) Indicators. Colombo: Department of Census and Statistics. http://www.statistics.gov.lk/MDG/Mdg.pdf (accessed 29.05.2017.)

15. Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB. Designing clinical research. Lippincott Williams & Wilkins; 2013 May 8.
16. Guidelines on Nutrition Rehabilitation Programme, (2007) WHO/UNICEF,,Sri Lanka.
17. Sivashankar JT, Thalagala N. The effectiveness of a homemade supplementary food in improving weight gain of children between 02 to 05 years age with moderate acute malnutrition in Kopay Western Province. Journal of the Postgraduate Institute of Medicine. 2017 Jan 3;3. http://doi.org/10.4038/jpgim.8134