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Efficacy of health mix supplementation on malnourished children (3-5 years) in Sholayoor tribal region

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Abstract
One among India's greatest human development challenges were malnutrition, which was India's silent emergency. The malnutrition was real and its crisis had profound and frightening implications for children, society and the future human kind. Malnutrition affects children's changes of survival, increases their susceptibility to illness, reduces their ability to learn and make them less productive later in life. This study was designed to determine the effect of formulated health mix powder on nutritional status of Preschool children. The study was carried out in Sholayoor tribal region. Total samples of 300 pre-school (3-5 years) children were selected randomly by purposive sampling method. Total number of 60 moderate acute malnourished (MAM) children was selected to participate in the intervention. The selected children were divided into two groups. The groups consisted of Control group (n=30) and Experimental group (n=30). The health mix powder was prepared in three variations. Based on the organoleptic evaluation, variation I was selected and considered for supplementation. This was used for shelf life study. From the shelf life study it was revealed that the formulated product could be used up to one month without any spoilage. The formulated health mix supplementation was provided to the experimental group, daily two times for a period of 90 days. The biochemical parameters like Serum total protein level, serum albumin and globulin level, blood haemoglobin level, clinical symptoms, anthropometric measurements and nutritional knowledge were assessed initial and finally. This study results concluded that the health mix powder increased the anthropometric and haematological parameters in the experimental group.

Keywords: malnutrition, health mix, supplementation, nutritional assessment, moderate acute malnutrition, shelf-life study

Introduction

Preschool age was one of the most vulnerable periods mainly due to easy susceptibility to malnutrition and infection leading to stunting of physical growth and suboptimal intellectual growth (Reddy, 2006). Malnutrition remained a major cause of morbidity and was the most common worldwide cause of death in children who were less than five years of age. Malnutrition was one of the single greatest threats to child survival, associated with 3.1 million child deaths each year of which half a million from wasting as a result of malnutrition– or 45% of all child deaths worldwide (Black *et al.*,2013) [2]. India contributed for more than 20 percent of the child deaths in the world. In India about 1.83 million children died annually before completing their fifth birthday and most of them due to preventable causes (UNICEF, 2009) [13]. Malnutrition of preschool children was a serious problem in developing countries. Malnutrition was associated with poverty and disease. So, the three factors were malnutrition, poverty and disease, are interlinked in such a way that each contributes to the presence and sustained effect of the other. Due to poverty, a significant portion of the population was unable to procure enough food and ultimately, they become malnourished and vulnerable to diseases like diarrhoea and parasitic infection. These often resulted from poor sanitation and drinking water facilities. Frequent attacks of diarrhoea and parasitic infection due to the poor health status of children and poor sanitary conditions ultimately lead to further aggravation of disease (Dasgupta *et al.*, 2005). Malnutrition of preschool children is a serious problem in developing countries. Malnutrition was associated with poverty and disease. So, the three factors were malnutrition, poverty and disease, and were interlinked in such a way that each contributes to the presence and sustained effect of the other. Due to poverty, a significant portion of the population was unable to procure enough food and ultimately, they became malnourished and vulnerable to diseases like diarrhoea and parasitic infection. These often resulted from poor sanitation and drinking water facilities. Frequent attacks of diarrhoea and parasitic infection due to the poor health status of children and poor sanitary conditions ultimately lead to further aggravation of disease (Dasgupta *et al.*, 2005). Provision of Protein-Based Food remained an important strategy for the prevention and treatment of malnutrition and could produce substantial improvements in the functional performance of malnourished individuals and populations. Many potential benefits of Protein-based Food required further exploration, including its effect on physical and mental development among children. There was strong evidence that Protein-Based Food intake had positive impact on weight gain, bone density, micronutrients repletion and cognition development among vulnerable populations. This review would shed the light on different intervention trials designed to tackle malnutrition by using animal source food provision, particularly, Milk and eggs (Naser, 2016) [6].

Moderate acute malnutrition (MAM) affected approximately 10% of the children under five years of age in low and middle income countries. Different approaches had been used for the nutritional recovery of the children in these settings such as lipid based nutrient supplements (food with high energy density and high lipid content) or blended foods (dry food mixtures without high lipid content), which could be provided in a low dose or full dose as a supplement to their habitual diet (Lazzerini *et al*., 2013) [5]. Integrated nutrition interventions using locally available health resources yielded the best results. However, sound evidence on the most effective interventions was still lacking. Intervention studies with comparison groups were necessary to obtain more robust evidence on the effectiveness of nutrition interventions.

Materials and Methods

Selection of the Respondents

Three hundred preschool children in the age group of 3-5 years from tribal population in Sholayoor, Attappadi (Kerala) were selected from random sampling method and their nutritional status were assessed. Based on the results, 60 Moderate Acute Malnourished (MAM) children were identified and categorised into Experimental group (n=30) and Control group (n=30) (Rakotosamimanana *et al.* 2014).

Assessment of socio-economic cum diet survey

An interview schedule was formulated and the background information regarding socio-economic status, dietary pattern, food intake and anthropometric measurements and the effect of supplementation of health mix in prevention of Malnutrition for both the selected groups were collected (Tonguet-Papucci *et al.*, 2015) [12].

Assessment of Nutritional Status of the Respondents

Anthropometric measurements, biochemical assessment, clinical examination and dietary assessment were used to assess the nutritional status of the selected subjects (Bertoli *et al.*, 2006) [1].

Formulation of Health Mix Powder

The health mix powder was prepared from Rice, Black gram dal, Ragi, Bajra and jaggery. The raw ingredients were purchased from Sholayoor local market. The 15g, 20g, 15g of rice, 15 g, 20g, 20 g of Bajra, 20g, 20g, 15g of Ragi, 20g of Blackgrm dal, 30g, 20g, 30g of Jaggery was made into three variation. Each variation was made up to 100 g of Health mix powder. The control (100g) was prepared by 70g of rice and 30g of jaggery. The organoleptic evaluation was conducted with 30 semi trained panel members. The sensory parameters such as, appearance, colour, flavour, taste and over all eating quality was evaluated using five point hedonic scale. The Table 1 showed the organoleptic evaluation of the formulated Health mix powder (Borkotoky and Sarma, 2016) [3].

Table 1: Mean Organoleptic Evaluation of Health Mix Powder

Sl No	Criteria	Control	V I	V II	V III
1.	Appearance	4.25±0.85	4.25±0.85	3.25±0.44	4±0.79
2.	Colour	4.1±0.78	4±0	3.5±0.51	3.5±0.51
3.	Flavour	4.75±0.44	4.85±0.48	4±0	4±0.79
4	Taste	4.3±0.68	4.4±0.94	3.75±1.33	4±0.79
5.	Texture	4.75±0.44	4.8±0.41	4.5±0.51	4.5±0.88
6.	Overall acceptability	4.43±0.35	4.46±0.36	3.8±0.48	4±0.35

From the table 1, the organoleptic score of the Health mix Variation I got highest score namely 4.25±0.85 in appearance, 4±0 in colour, 4.85±0.48 in flavour, 4.4±0.94 in taste, 4.8±0.41 in texture and 4.46±0.36 in overall acceptability.

Nutrient Analysis of the Health Mix

The nutrients like energy, protein, carbohydrate, fat, fibre, Calcium, Iron were analyzed for the control and highly accepted V-I product (Onwordi *et al*. 2009) [7].

Microbial Load

Microbial load was analysed for the Control and Variation V1. Total bacterial count was analysed using spread plate method for 30 days at 15 days interval (Surve and Rema, 2007) [11].

Supplementation of Health Mix Powder

Both the experimental and control group were given a Syrup of Albendazole (10ml) at base line to ensure that there was no worms and the intestinal track was clear for clear absorption of nutrients. The supplement was provided to the experimental group Health mix powder 30g (made into porridge) twice daily in morning and evening for a period of 90days and carefully monitored and ensured the consumption of supplement with the help of field level staff. Control group did not receive any supplement during the study period. Nutritional education also given to the mothers of control and experimental groups before and after supplementation. Anthropometric, biochemical and clinical parameters were recorded before and after supplementation to access the effect of supplementation in control and experimental group (Robertson, 1989) [10].

Result and Discussion

Background Information

Most of the respondents were from nuclear family. In general 69 percent of families belonged to nuclear family and rest of them (31 percent) was being in the joint family system.47 per cent of the respondents were have a income of 5000-1000, the 24 % of people have 3000-5000, 18 % of people have <3000, only 11% of parents have more than 10000 rupees income per month. From the study it was evident that most of the parents were labours (60%), remaining respondents were agriculture people (30%) and government staffs (10%). Similar statistics were observed by Kalathil in 2004 [15].

Dietary pattern of the subjects

90 per cent respondents were non-vegetarians and 1 percent were vegan, 3 per cent of the subjects belonged to lacto vegetarian, 2 per cent were ova vegetarian and 4 per cent were pesco vegetarian.100 per cent of the preschool children were breastfed in the initial stages of their infancy. 40 per cent of selected subjects were introduced to weaning even before 6 months of age. 60 per cent were given weaning foods only after 6 months of age.70 per cent of the subjects consumed 3 meals per day, 20 per cent of the children consumed 4 meals per day and only 10 per cent of the subjects consumed more than 4 meals per day.36 per cent of the children daily attended anganwadi for feeding. Rest of the 64 per cent not attended daily anganwadi feeding. This dietary pattern was observed in Africa (Turi and Grigsby-Toussaint, 2012; Neale, 1993) [16, 17].

Morbidity pattern and Clinical examination

Frequent illness was one of the major causative reason for malnutrition, from the study it was evident that 34 % of respondent had illness of once in 15 days, 30% of the pre-schoolers had illness once in two months, 20% of children had illness monthly once, 30 % of children had weakness weekly once, and one per cent of children had illness daily. It was found that the 12 % children were admitted in NRC for the management of Severe Acute Malnutrition, 36 % children were enrolled in community based management of Severe Acute Malnutrition programme for the treatment of Severe Acute Malnutrition. 30 per cent of the respondents had general weakness, dryness of hair, 23 per cent, angular stomatitis and cheilosis affected 7 per cent, glossitis caused 2 per cent, pale skin complaints had 36 per cent, ridged nails had 2 per cent, and tooth decay found in 30 per cent among selected respondents. These malnutrition pattern was observed in adolescent girls of tribal region by Attie and Brooks-Gunn in 1989 [18].

Anthropometric measurements and grade of malnutrition

The mean height of the subjects found to be 95.36±5.72 cm, while mean weight was 12.76±1.86 kg, and the mid upper arm circumference to be 141.87±10.83 mm. To evaluate the prevalence of the malnutrition among preschool children, the data on height and weight were classified using standard deviation (Z scores) weight for height using WHO standards (WHO, 2006) [14]. The prevalence of malnutrition among selected subjects given in table 2**.** Fernandez-Mendoza *et al.* in 2010 observed a relation between insomnia and other neurological effect in subjects under malnutrition.

Table 2: Prevalence of Malnutrition among Selected Subjects (N=300)

Sl. No	Nutritional status (weight for height)	Number	Percentage
1.	Normal	230	76.6
2.	Moderate Acute Malnutrition	63	21
3.	Severe Acute Malnutrition	7	2.4

Nutrient analysis of Health mix

The nutrients were analysed for the control and Variation I. Control contained energy of (359.6kcal), Carbohydrate (84.1g), Protein (4.7g), Fat (0.2g), Crude fibre (0.11g), Moisture (4.83g), Calcium (34mg) and Iron (3.2mg). Variation I contained energy of (370.02 kcal), Carbohydrate (83.71g), Protein (9.63g), Fat (0.74 g), Crude fibre (2.16 g), Moisture (4.85 g), Calcium (262 mg) and Iron (8.3 mg). When compared with control all the nutrients were higher in Variation I. The nutritional analysis of this health mix was conducted in cattle of Savannah and received higher yield of milk (Roodt, 2012) [20].

Microbial analysis of Health mix

The total bacterial count of the control and Variation I were absent on first day. At the fifteenth day of storage the total bacterial count was 8×10^4cfu/ml and on 30th day the total bacterial count was 14×10^4cfu/ml and 12×10^4cfu/ml respectively. The fungal count was absent in first day of storage in control and variation I. On the 15th day of storage the fungal count was 1×10^4cfu/ml in control and Variation I. On the 30th day of storage the fungal count was 2×10^4cfu/ml in control and variation I. A study by Simforian in 2013 showed higher microbial load in the same health mix proportion. Henceforth this health mix provided a safe source of nutrition for infants.

Effect of Supplementation of Health Mix Powder on Selected Respondents

To access the impact of supplementation the anthropometric assessment clinical assessment and biochemical assessment were recorded before and after supplementation.

Mean Height of the Selected Subjects before and after Supplementation

The initial height of the control subjects and experimental subjects were 94.40±5.63 and 94.97±6.47 respectively. The final mean height of the control and experimental group was 95.10±5.58 and 96.43±6.37. Table 3 showed the Mean height of the selected subjects before and after supplementation.

Table 3: Mean Height of the Selected Subjects before and after Supplementation (N=60)

Subjects	Height (cm) Mean ±SD		Difference (cm)
	Initial	Final	
Control group	94.40±5.63	95.10±5.58	0.7±0.05
Experimental Group	94.97±6.47	96.43±6.37	1.46±0.1

Mean Weight of the Selected Subjects before and after Supplementation

The mean weight of the control subjects before and after supplementation was 11.36±1.29 and 11.62±1.33, and in experimental group 11.54±1.41 to 13.04±1.58. The mean increment of weight in control subjects was 0.26 kg and in experimental group it was found to be 1.5 kg. Table 4 showed the increment of weight in selected subjects before and after supplementation.

Table 4: Mean Weight of the Selected Subjects before and after Supplementation (N=60)

Subjects	Weight (kg) Mean ±SD		Difference (kg)
	Initial	Final	
Control group	11.36±1.29	11.62±1.33	0.26±0.04
Experimental Group	11.54±1.41	13.04±1.58	1.5±0.17

Mean MUAC of the Selected Subjects before and after Supplementation

The initial MUAC of the control and experimental subjects were 132.1±6.86 and 130.23±4.53 respectively. The experimental group had slight increase in Mid Upper Arm Circumference with a difference of 3.77± 0.45. Table 5 showed the increment of MUAC in selected subjects before and after supplementation.

Table 5: Mean MUAC of the Selected Subjects before and after Supplementation (N=60)

Subjects	MUAC (mm) Mean ±SD		Difference (mm)
	Initial	Final	
Control group	132.1±6.86	132.3±6.81	0.1±0.05
Experimental Group	130.23±4.53	134±4.98	3.77±0.45

Mean Serum Total Protein of the Selected Subjects before and after supplementation

It was found that the initial levels of serum total protein of the control and experimental subjects were 6.12±0.31 and 5.63±.50. After supplementation the mean serum total protein level was found to be 6.13±0.33 and 6.43±0.49 respectively for control and experimental subjects. Table 6 showed the Mean serum total protein of the selected subjects before and after supplementation.

Table 6: Mean Serum Total Protein of the Selected Subjects (N=60)

Subjects	Serum Total Protein (g/ml) Mean ±SD		Difference (g/ml)
	Initial	Final	
Control group	6.12±0.31	6.13±0.33	0.01±0.02
Experimental Group	5.63±0.50	6.43±0.49	0.8±0.01

Mean Albumin in Selected Subjects before and after Supplementation

The initial levels of serum albumin of the control and experimental subjects were 3.60 ±0.29and 3.55 ± 0.27. After supplementation the mean albumin level was found to be 3.55±0.27 and 4.03±0.32respectively for control and experimental subjects. The increment was found control group and experimental group was 0.03±0.01 and 0.48±0.05 respectively. Table 7 showed the mean albumin level of the selected subjects before and after supplementation.

Table 7: Mean Albumin in Selected Subjects before and after Supplementation (N=60)

Subjects	Albumin (g/ml) Mean ±SD		Difference (g/ml)
	Initial	Final	
Control group	3.60±0.29	3.63±0.30	0.03±0.01
Experimental Group	3.55±0.27	4.03±0.32	0.48±0.05

Mean Globulin Level of the Selected Subjects before and after Supplementation

It was found that the initial levels of serum globulin of the control and experimental subjects were 2.43±0.27 and 2.40±0.25. After supplementation the mean globulin level was found to be 2.50±0.29 and 3.04±0.23 respectively for control and experimental subjects. The increment was found control group and experimental group was 0.07±0.02 and 0. 0.64±0.02 respectively. Table 8 showed the mean increment of Serum globulin level in the selected subjects.

Table 8: Mean Globulin of the Selected Subjects before and after Supplementation (N=60)

Subjects	Globulin (g/ml) Mean ±SD		Difference (g/ml)
	Initial	Final	
Control group	2.43±0.27	2.50±0.29	0.07±0.02
Experimental Group	2.40±0.25	3.04±0.23	0.64±0.02

Mean Haemoglobin Level of the Selected Subjects before and after Supplementation

From the study it was found that the initial levels of haemoglobin of the control and experimental subjects were 8.39±1.30 and 8.39±1.30. After supplementation the mean haemoglobin level were 8.53±1.36 and 9.40±1.24 respectively for control and experimental subjects. The increment was seen in control group and experimental group was 0.14±0.06 and 1.01±0.06 respectively. Table 9 showed the mean increment of hemoglobin level in the selected subjects.

Table 9: Mean Haemoglobin Level of the Selected Subjects before and after Supplementation (N=60)

Subjects	Haemoglobin (g/dl) Mean ±SD		Difference (g/dl)
	Initial	Final	
Control group	8.39±1.30	8.53±1.36	0.14±0.06
Experimental Group	8.39±1.30	9.40±1.24	1.01±0.06

Conclusion

The supplementation of the formulated health mix powder aided significant changes in the anthropometric as well as biochemical status of the moderate acute malnourished children in the experimental group. Before imparting nutrition education, the score for knowledge, attitudes and practices were low among the subjects in both control and experimental group. After imparting nutrition education the knowledge, attitudes and practices relating to nutrition had improved among the control and experimental groups. The shelf life study the formulated health mix powder can use up to one month without any deterioration. This study showed that consumption of nutrients dense as well locally available cereals pulse combination recipes were highly beneficial to the nutritional status of the respondents. It was the responsibility of the nutrition community to help people and create awareness about the nutritional importance to tribal population. This study here by identified the easy way of minimizing the prevalence of malnutrition among the community by the consumption of locally available nutritious foods.

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