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RESEARCH ARTICLE

Effect of health mix supplementation on nutritional status of Pre school girls

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Introduction

Nutrition during early childhood is of paramount importance because it is a foundation for life time health, strength and intellectual vitality and it is characterized by rapid growth with increased muscle mass, growth of organs, expansion of blood volume and linear increase in the long bones. Children need proper nutritional care not only to promote and also maintain their optimum health and nutritional status. Provision of adequate dietary energy and macro and micro nutrients for growth and development should be the principle determinant of the diet of growing children Iyengar (2002) points out that the energy is required for growth and physical and mental activities. Insufficient food will, not only result in under nutrition in terms of inadequate weight gain but will also hinder growth of the children. Fat energy including invisible fat for children should be 25 per cent of total energy and essential fatty acid energy is 5-6 per cent The changes in food habits, food preferences, life style etc., of an individual affect their health and nutritional status. Age and dietary intake are significantly associated with malnutrition. Calorie and protein deficit are being identified as the major factors responsible for the occurrence macro nutrients deficiency diseases

Consumption of an inadequate diet with less amounts of vitamins and minerals causes micronutrient malnutrition. Lowered resistance to infection, poor cognitive development, retardation of physical and mental development, fatigue, lowered physical activity; poor mental concentration and productivity are the major consequences of these deficiency diseases (Prabhakaran, 2006).Local resources and technology seem to be the most relevant solution to the nutritional problems of PEM and micro nutrient deficiency. Plant proteins, especially pulses and oil seed proteins rank foremost in its nutrient content and versatility of product development. Soybean combination with cereals and oil seeds is often referred to as a boon to solve macro and micronutrient deficiency. This type of food supplement is an attractive and least expensive strategy to reach the quality, food for young children, with these strategies, it is hopefully expected to enhance nutritional status and eliminate deficiency diseases among the young children. Thereby next generation of younger will lead a more healthy life.

Keeping all these points in mind, the investigator took interest to conduct the present study on "**EFFECT OF SUPPLEMENTATION OF LOW COST HEALTH MIX ON NUTRITIONAL STATUS OF PRE-SCHOOL GIRLS**" with the following objectives: To

1. elicit information on socio-economic background and dietary pattern of the selected subjects
2. identify girls for supplementation study
3. formulate and evaluate health mix for supplementation and
4. assess the effect of supplementation on nutritional status of the selected subjects in the study groups

METHODOLOGY

A total of 106 children in the age group of 4 - 6 years, attending the primary school were selected through random sampling for the present study. In the purposive sampling method, the investigator uses his or her own judgment about the respondent to choose

or pick the best to meet the purpose of the study. Hence, purposive sampling was adopted for selection of sub samples for further in-depth study. The criteria used for the selection of sub-samples were: In the age group of 4 -6 years from either low or middle income families' ii. Anthropometric measurements should be below the NCHS standard values and also iii.Hemoglobin value should be below the standard value of WHO (2004).

i. Formulation and evaluation of health mix for supplementation

Food supplementation is one of the most effective ways of improving health status and preventing deficiency diseases. Hence, the investigator thought of formulating nutrient dense health mix in the form of sweet ladoo, using the ingredients of ragi, soya bean, groundnut and jaggery for the preparation. Ragi is superior to rice and wheat in certain constituent of calcium. This finger millet protein has well balanced amino acid profile and is a good source of methionine, cystine and glycine and contributes vitamins like thiamine, riboflavin, foline and niacin. Soya flour was chosen for incorporation as it is less expensive yet rich in calories, protein, fats, vitamins and minerals. Soya contains 45 percent of protein of high biological value.Though methionine is the limiting amino acid and its lysine and threonine content is high, thus making it as a good supplement of cereal protein. Groundnuts are valuable for its calorific value and jaggery for its iron content. Combination of these ingredients contributes good quality and quantity of nutrients and make this food based supplement as an excellent food item for improving the health status of the growing children. Totally 20 variations, 4 from each of five formulations were developed. In all the 20 formulations, ingredients were incorporated at different level. Ingredients used were accurately weighed; all these ingredients except jaggery were carefully roasted to enhance the flavor and texture and finely powdered with jaggery and cardamom. Then the processed ingredients were evenly mixed and made into small balls. The small balls were termed as sweet ladoo.Acceptability study was conducted for the 20 variations of the five formulated mixes using sensory evaluation based on characteristics such as appearance, color, flavor, taste and texture, with the help of score card by a group of ten qualified taste panel members of post graduate students. From the 20 formulated mixes, variation which secured maximum score in the acceptability trials was selected for supplementation study.

ii. Nutrient content of the supplement

Table - II gives the amount of ingredients used in the preparation of supplement and nutrients contribution of energy, protein, fat, calcium, iron beta-carotene, thiamine and riboflavin content. No single legume or cereal provides adequate amounts of all nutrients to meet the nutritional requirements of a child. However, even before knowledge on protein content, protein quality, digestibility and the nutrient requirements of humans became available, it was recognized that mixing legumes with cereals in the diet improve overall nutrition.

iii. Assessing the effect of health mix on nutritional status of the selected study groups

Sub samples selected were grouped into experimental group (N=20) and control group (N=20). The experimental group received the 25g of health mix in mid-morning, daily for two months. There was no nutritional supplementation was provided for the control group during the study period of two months Nutritional status of an individual can be determined with the help of anthropometric measurements, individual dietary intake, clinical examination of symptoms of nutritional deficiencies and laboratory investigations of bio-chemical estimation. The commonly used biochemical indices for the study were estimation of hemoglobin, serum total protein, albumin, and globulin and albumin/globulin ratio. Blood parameters analyzed before and after supplementation were compared to find out the effect of supplementation on the selected study groups. Combination of these methods provide better picture of assessment of nutritional status of the target groups. Hence, the investigator desired to include all these four aspects for assessing the health status of the study groups.

TABLE – I NUTRIENT CONTENT OF THE SUPPLEMENT

Ingredients	Amount (g)	Energy (Kcal)	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Beta-carotene (µg)	Thiamine (mg)	Riboflavin (mg)
Ragi	5	16.4	0.365	0.065	17.2	0.195	2.1	0.021	0.095
Soyabean	5	21.6	2.16	0.972	12.0	0.520	21.3	0.036	0.019
Groundnuts	5	28.5	1.31	1.99	3.85	0.155	0	0.019	0.065
Jaggery	10	38.3	0.04	0.01	8.0	0.264	-	-	-
Total	**25**	**104.8**	**3.875**	**3.037**	**41.05**	**1.134**	**23.4**	**0.076**	**0.179**

TABLE- II QUANTITY OF HEALTH MIX CONSUMED BY THE SELECTED SUBJECTS IN THE STUDY GROUPS

S. No	Healthmix based on	Mean quantity of health mix(g)		
		Given	leftover	consumed
1	Rice, (Horsegram, Groundnuts, Jaggery)	25	5	20
2	Ragi, (Soyabean, Groundnuts, Jaggery)	25	0	25
3	Wheat, Roasted (Bengal gram, Sesame seeds, Jaggery)	25	5	20
4	Maize, (Black gram dhal, sesame seeds, Jaggery)	25	10	15
5	Bajra,(Green gramdhal,Groundnuts, aggery)	25	12	13

TABLE – III. HEIGHT OF THE SELECTED SUBJECTS IN THE STUDY GROUPS (BEFORE AND AFTER SUPPLEMENTATION

Age (yrs)	Experimental				Control			
	Mean ± SD		Mean difference	't' value	Mean ± SD		Mean difference	't' value
	Initial	Final			Initial	Final		
5	110.020 ± 7.540	111.940 ± 7.569	1.92	13.535**	110.125 ± 0.08	110.205 ± 7.569	0.08	2.138^{NS}
6	114.322 ± 5.909	115.466 ± 5.852	1.144	6.091**	115.814 ± 5.217	115.742 ± 5.216	0.072	2.500^{NS}

NCHS-National Centre for Health Statistics (2002)

** - Significant at 1% level; * -Significant at 5% level; NS - Non significant

RESULTS AND DISCUSSION

A. Mean quantity of health mix in the form of sweet ladoo consumed by the selected subjects.

Among the 20 varieties of health mix with 5 variations, most acceptable by the panel members were further evaluated for its acceptable quantity of consumption by the subjects in each of the study groups The formulated health mix based on Ragi, Soybean, Groundnuts and jaggery was completely consumed by the preschool children .All the girls in the study groups expressed that soybean health mix was very good and ready to consume completely

B**. Effect of supplementation of low cost health mix on nutritional status of girls in the study groups**

Early childhood is a period of rapid physical and mental growth and development and their nutritional requirements are higher per unit of body weight than those of adults (Sarojini, 2003). Children are sustainable to have deficiency diseases that include Vitamin A deficiency, iron deficiency anemia and iodine deficiency disorders. Food based approach with macro and micro nutrients are very effective to enhance the nutritional status of an individual. To assess the effect of supplementation on the nutritional status of the selected children, nutritional anthropometric measurements, clinical examination, individual dietary intake and biochemical estimation were carried out and data collected are given as follows:

i. Nutritional anthropometric measurements

Anthropometric measurements included in the present study are height, weight, body mass Index, head and chest circumference, mid-arm circumference and grade malnutrition of the selected subjects in the study groups

1. Mean height of the selected subjects in the study groups

Table III gives the details of regarding the height of the selected subjects in the study groups.

The mean height of the selected subjects aged 5 and 6 was 110.02 and 114.32, respectively before supplementation. After supplementation, it is evident to note that there was a statistically significant improvement at one per cent level and it was observed in the experimental and there was no increment in the height of the selected subjects in the control group. By conclusion, the height of the selected subjects in the age group of five and six were below the NCHS standard value and it reflects the poor nutritional status of the subjects in the study groups.

ii. Mean weight of the selected subjects in the study groups

Table -VI gives the details regarding the weight of the selected subjects in the study groups.

Table – IV Weight of the selected subjects in the study groups

Age (yrs)	Experimental				Control			
	Mean ± SD		Mean difference	't' value	Mean ± SD		Mean difference	't' value
	Initial	Final			Initial	Final		
5	17.165 ± 2.918	18.619 ± 2.790	1.454	11.282**	17.374 ± 1.536	17.166 ± 1.530	0.208	2.004 NS
6	18.610 ± 3.477	19.843 ±3.238	1.233	10.961**	18.75 ± 2.302	18.861 ± 2.335	0.11	1.565 NS

NCHS-National Centre for Health Statistics (2002) The mean weight of selected subject in both experimental and control group was below the NCHS standard values.

iii. Severity of malnutrition among the selected subjects in the study groups

Table-V presents the information pertaining to the severity of malnutrition found to exist in the selected subjects of the study groups. The Indian Academy of pediatrics (2002) recommended the following classification for the grade

of malnutrition and it denotes that > 90%, 60-75%, 75-90%, <60% as normal, first, second and third grade of malnutrition respectively.

Table –V Severity of malnutrition

Cut off level as % of NCHS mean	Experimental								Control							
	5 years				6 years				5 years				6 years			
	Initial		Final		Initial		Final		Initial		Final		Initial		Final	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
<60 Grade III/third degree	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60-75 Grade II/second degree	2	10	-	-	1	5	-	-	6	30	6	30	5	25	7	35
75-90 Grade I / first Degree	8	40	4	20	7	35	10	50	4	20	4	20	5	25	3	15
>90 Normal	-	-	6	30	2	10	-	-	-	-	-	-	-	-	-	-

As per percentage of weight for age the experimental group and control group of 5 years and 6 years initially belonged to grade I and grade II degree of malnutrition and after supplementation, the grade of malnutrition slightly positively from grade II to grade I and from grade I to normal and it indicates the effect of supplementation on nutritional status of the supplemented group.

From the Table, it is evident that fifty per cent of selected subjects and 50 per cent of selected subjects in experimental and control group respectively were aged 5 years and belonged to the category of grade I and grade II malnutrition respectively. Forty per cent of the selected subjects in the experimental group and 50 per cent of the selected subjects in the control group belonged to the age of 6 years belonged to the category of grade I and grade II malnutrition respectively. Forty per cent of the selected subjects in the experimental group and 50 per cent of the selected subjects in the control group belonged to the age of 6 years belonged to the category of grade I and grade II malnutrition.

The collected data also revealed that the head, chest and mid arm circumference of the selected subjects in the experimental group showed meager difference after supplementation and in control group there was no marked difference in head, chest and mid arm circumference in head, chest and mid arm circumference. It might be due to short period of the study.

C. Mean daily food and nutrients intake of the selected subjects

The food intake of the selected subjects was inadequate in both experimental and control group. The inadequacy was most prominent for pulses, fats and oils, fruits, vegetables, green leafy vagetables, milk and milk products when compared with ICMR RDA. As they consume less amount of nutritious food, their nutrient intake was also low. The deficit energy intake was only nine per cent, but the deficit is more in all other nutrients like protein, iron, beta carotene and water soluble vitamins.

D. Biochemical profile of the selected subjects in the study groups

1. Hemoglobin estimation

Haemoglobin level of the selected subjects in the study groups before and after supplementation was recorded.Table-XXV and figure-VIII give the information regarding haemoglobin level of the selected subjects in the study groups, before and after supplementation.

Table –VI Haemoglobin level of the selected subjects in the study groups

Age (yrs)	Experimental				Control			
	Mean Haemoglobin ± SD		Mean difference	't' value	Mean Haemoglobin ± SD		Mean difference	't' value
	Initial	Final			Initial	Final		
5	9.975 ±0.731	11.891 ±0.955	1.916	7.987**	11.240 ±0.218	11.292 ±0.226	0.052	1.372^{NS}
6	9.412 ±1.331	11.628 ±0.944	2.216	4.118**	11.477 ±0.432	11.482 ±0.426	0.005	1.922^{NS}

** - significant at 1% level; NS- Not significant

The statistical analysis revealed that one per cent significant difference was noted in the increment of hemoglobin level of the experimental group. This also indicates that supplementation of cereal-pulse based health mix improves hemoglobin level and prevent the occurrence of anemia.

2. Serum Total protein (Albumin, Globulin, Albumin/globulin Ratio)

Table-VII elicit information regarding the level of serum total protein, albumin, globulin, albumin/globulin ratio before and after supplementation of 60 days.

Table-VII Total protein, albumin, globulin level and albumin/globulin ratio of the selected subjects in the study groups

Age (Yrs)	Group	Total Protein (g/dl)			Albumin (g/dl)			Globulin (g/dl)			Albumin/Globulin Ratio		
		Initial	Final	't' Value	Initial	Final	't' Value	Initial	Final	't' Value	Initial	Final	't' Value
5	Experimental Mean ±SD	7.077 ±0.264	7.888 ±2.225	4.208**	4.259 ±0.339	4.751 ±0.242	8.879**	2.818 ±0.280	3.137 ±0.477	2.987*	1.313 ±0.152	1.964 ±0.622	5.291**
	Control Mean±SD	7.644 ±0.226	7.638 ±0.226	0.885^{NS}	4.244 ±0.505	4.044 ±0.505	0.367^{NS}	3.400 ±0.184	3.594 ±0.181	2.449^{NS}	1.266 ±0.160	1.270 ±0.171	0.431^{NS}
6	Experimental Mean ±SD	7.676 ±0.276	7.938 ±0.124	4.398**	4.919 ±0.137	4.619 ±0.137	9.591**	2.757 ±0.400	3.019 ±0.323	2.604*	1.211 ±0.069	1.292 ±0.062	8.679**
	Control Mean±SD	7.642 ±0.316	7.635 ±0.315	0.500^{NS}	4.974 ±1.204	4.674 ±1.204	0.367^{NS}	2.668 ±0.108	2.661 ±0.019	1.216^{NS}	1.465 ±0.276	1.512 ±0.267	1.073^{NS}

**- Significant at 1% level *- Significant at 5% level NS- Not significant

The mean total protein level of the selected subjects in the experimental groups aged 5 and 6 years was 7.077 g/dl and 7.676g/dl, albumin level was 4.259 g/dl and 4.919 g/dl, globulin level was 2.818 g/dl and 2.757 g/dl respectively, the level of the total protein increased to 7.888 g/dl and 7.938 g/dl, albumin 4.751 g/dl and 4.619 g/dl and globulin 3.137 g/dl and 3.019 g/dl respectively. The significant increment, in the total protein and albumin was at one per cent level and for globulin the increment was at five per cent level, was observed in experimental group.Above data also showed that, in experimental group, total protein, albumin, globulin, albumin/globulin ratio increased significantly at one per cent level and globulin increased at five per cent level. In the case of control group, there was no significant increase in total protein, albumin, globulin, albumin/globulin ratio of the selected subjects in the study groups. The increment in serum protein profile of the experimental groups was mainly due to the protein content of sweet ladoo used in supplementation study.

Conclusion

Children are the human resource and assets of a country. A nation's health is gauged through the health of its children. It is therefore essential that children are allowed to grow in an environment which is suitable to meet their nutritional, social, emotional and educational needs, Development. Hence it is essential to include foods rich in macro and micro nutrients constantly in our regular diet for healthy and desirable blood profile of the body. The maintenance of micro nutrients stores in the body helps to meet the need for growth and development of the young children and also for the preparation of the future adolescents, adulthood and motherhood

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