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A Systematic Review Analysis On The Effect Of Supplementary Snack On Underweight Children Based On WHO Norms.

Dr.Jyothi.H

Assistant Professor (Food & Nutriion), Department of Homescience Government College for Women, Trivandrum, Kerala, India PIN 695014. Email jyothiunni8@gmail.com

ABSTRACT

The period of pre-school children is an important stage for formation and preservation of health in the future. (Bergier et al., 2016). The aim of this research is to study the effect of a developed traditional supplementary snack on underweight preschoolers. The sample comprised of preschool children of 42-48 months, from the rural areas of Malappuram district, Kerala. Normal weight for age children formed the control group and underweight children constituted the experimental group. The anthropometric standards of the control group and experiment group showed statistical significance with respect to their height, weight, head circumference, chest circumference, and MUAC measurements. The average weight of children in control group lies in between the WHO reference median and -1SD value. The traditional supplementary snack was made from Barley, green gram, sesame seeds, jaggery and ghee. It provided an additional 1/3 calories for the experimental group. Two balls (100gm) rich in macro and micronutrients (436.5 calories, 8.2 g protein, 171 mg calcium, 119.5 mg phosphorous and 2.55 mg iron) were supplemented daily for a period 3months. The cost was Rs. 4.25 /ball(50g).The present study indicated that blending traditional supplementary food can improve the growth rate of underweight preschool children and help catch up and reach normal standards.

Keywords: Preschool children, supplementation, supplementary snack, weight for age, underweight, Barley, green gram, sesame

INTRODUCTION

Nutritional status is the great mirror which shows the healthcare practices and its determinants of any country (Black et al., 2013). The nutritional status of the children can be evaluated by their growth in terms of physical, mental as well as biological characteristics by stunting, wasting, and underweight. Malnutrition and morbidity is strongly associated with the way availability of nutritional food for children, poor nutrition affects the physical development as well as mental development of the children thus resulting in stunting, wasting and underweight. Balanced diets and diversity of food are not accessible to a large proportion of the world particularly those who live in developing countries. Many populations subsist on staple plant-based starchy monotonous diets. Preschool children are one of the most nutritionally vulnerable segments of the population. Worldwide it is estimated that every fourth child is affected by protein-energy malnutrition.

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The most neglected form of human deprivation is malnutrition, particularly among preschool children. Kerala's health care system is moving through a very turbulent period. Despite having the best indicators on child development, certain disturbing trends have emerged in the State in recent years. This includes poor maternal nutritional status and a high rate of anaemia among women and children, etc. (NFHS-3, 2005-06).__Supplementary food is any combination of ingredients which should be calorie dense, and can full fill and correct nutritional deficiencies in growing children. Effective supplementary food will meet additional one third calorie requirement for moderately malnourished children (Elizabeth et al., 2016). Targeted Supplementary Feeding Programmes (TSFPs) are the most commonly used approach for treating MAM (Annan et al., 2014). Targeted Supplementary Feeding Programmes use a variety of different products, including fortified blended flours and ready-to-use supplementary food (RUSF) supplements (Lenters et al., 2013). The World Health Organization has issued guidance on the recommended nutrient composition of such supplements (WHO, 2012).

Some studies have suggested that nutrition counseling, particularly focusing on improving infant and young child feeding practices, may be as effective as specialized food-based interventions for the treatment of MAM (Nikiema et al., 2014, Ashworth & Ferguson, 2009).

Strategies for tackling childhood stunting and micronutrient deficiencies may include child-centred specific nutrition counseling, cash transfers, linkage to social protection services (safety net programme, income generation schemes), a food multimix approach using locally available food, and using specialised food supplements such as fortified blended flours or ready-to-use supplementary foods (Lenters et al., 2013., Nikiema et al., 2014., Ashworth & Ferguson, 2009., Zotor & Amuna, 2008). There was a significant association between continued breastfeeding for 1 year and childhood stunting. The author suggests supplementary feeding for children who are breastfed for minimum for one year or more (Nsereko et al., 2018).

Kerala has achieved many targets such as improving child mortality, decreasing women deaths in pregnancy and improving the birth weight of children, but lack of awareness on nutrition, improper selection of food items during the weaning period affects the child's nutritional status according to the data available from NFHS-4 Kerala (2015- 2016). The present experiment was conducted to assess the impact of supplementary food on the nutritional status of low weight preschool children who were identified from the rural areas of Malappuram district. In this interventional experiment, a food supplementation strategy was administered to compensate for the weight of low weight for age children.

Methodology

This study assessed the effect of supplementation of the developed snack for preschool children of low weight for age (3½ - 4 years, ie 42 - 48 months, N = 50).**T**wenty-five children with normal weight for age were selected as control group and twenty-five children with low weight for age were selected as experiment group. The product developed was given as food supplement for a period of 3 months (90 days) for experiment group. Data pertaining to anthropometry were collected before and after

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intervention. The dietary profile collected before intervention using 24 hour recall for three days and the nutrients were computed. The supplemented snack contains 439 calories, 7.8g protein, 96.5 mg calcium, 133 mg phosphorous and 2.41mg iron per 100g of 'ladoo'. The cost was Rs 4.25 /ball, (50g).

Results and discussion

Table.1 Distribution of respondents on the basis of religion, caste & family size

Groups	Religion			Caste		Family size		
	Hindu	Muslim	Christian	Backward	SC	>5 members	5 members	4 members
Control group	7 (28%)	18 (72%)	0 (0%)	24 (96%)	1 (4%)	18 (72%)	5 (20%)	2 (8%)
Expt. Group	6 (24%)	19 (76%)	0 (0%)	23 (92%)	2 (8%)	23 (92%)	2 (8%)	0 (0%)

Table.1 shows, on basis of religion, 28 percent of the control and 24 percent in the experiment group belonged to Hindus, 72 percent and 76 percent from control and experiment groups respectively belongs to Muslims. 96 percent of the control group and 92 percent of experiment group were from the backward category. SC community in these groups was 4 percent and 8 percent respectively. Based on the size 72, 20, 8 percent of the family possesses more than five, five and four members respectively in the control group. In the case of experiment group, 92 percent of family had greater than five members, and 8 percent had 5 members in their family.

Table.2 Distribution of respondents on the basis of type of family, education & occupation

	Type of family		Educational status of parent (up to10th class)		Occupation of parent		
	Joint	Nuclear	Father	Mother	Coolie	Agriculture	Business
Control group	17 (68%)	8 (32%)	23 (92%)	18 (2%)	23 (92%)	0 (0%)	2 (8%)

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Experiment group	23 (92%)	2 (8%)	25 (100%)	13 (52%)	19 (76%)	1 (4%)	5 (20%)

From Table.2, 68 percent of children from the control group and 92 percent from the experiment group belongs to joint family. 92 percent of father and 72 percent of mother in the control group had education up to 10^{th} class. In the experiment group, 52 percent of mother and cent percentage father obtained education up to 10^{th} class. Majority of the parents from both the groups are daily wagers (92% and 76%). Moreover 4 percent depend on agriculture as their livelihood.

Table. 3 Variance analysis for control and experiment groups

Group	**Average monthly income (Rs.)**	**Per capita income (Rs.)**	**F-value**	**P-value**
Control group (N=25)	22080 ±1869	3723 ± 622	0.006	0.938
Experiment group (N=25)	22120 ± 1740	3499 ± 285	2.682	0.108

Table.3 shows that there was no statistical difference in the monthly income and per capita income of the control group and experimental group. Thus these groups show no economic disparity between them. Both the groups were homogeneous with respect to economic variable.

Table. 4 Analysis for association based on gender

Group	**Gender**		**Pearsons Chi- square**	**p-value**
	Male, (%)	**Female, (%)**		
Control group (N=25)	10, (40%)	15, (60%)	0.725	0.571
Experiment group (N=25)	13, (52%)	12, (48%)		

Table. 4 that shows gender participation in control and experiment groups. The Control group had a male participation of 40 percent and that of females is 60 percent. The experiment group constitutes 52 percent male and 48 percent female. The statistical test supported with the Pearson Chi-square value is 0.725 and the p-value is 0.571. This shows no statistical significance between the groups with respect to gender.

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Table. 5 Distribution of age of the groups

Groups	Mean months	Std. Deviation	F-value	P-value
Control group (N = 25)	46.400	1.9149	0.063	0.803
Experiment group (N=25)	46.280	1.4295		

Table.5 shows the mean age of the control group and the experimental group. The control group had a mean age of 46.4 months and in the experimental group it was 46.28 months. This shows no statistical significance between the groups with respect to their mean age.

Table. 6 Distribution of respondents based on exclusive breast feeding

Exclusive breastfeeding	Mean months	Std. Deviation	F-value	P-value
Control group (N=25)	5.040	0.6758	6.127	0.017
Experimental group (N =25)	4.600	0.5774		

Table.6 shows exclusive breastfeeding history of the respondents. The experimental group had exclusive breastfeeding duration of 5 months and experimental group had exclusive breastfeeding duration of 4.6 months, which showed no statistical significance. This indicated that both groups had a history of early introduction of weaning foods

Table.7 Distribution of mean birth weight of the groups

Groups	Mean birth wt. (kg)	Std. Deviation	F-value	P-value
Control	3.008	0.1631	60.809	0.000*
experiment	2.720	0.0866		

Table.7 shows the birth weight of the control group and experimental group. The control group had a birth weight of 3.0 kg and the experimental group it was 2.72 kg. This was statistically different between the two groups.

Table.8 Distribution of morbidity score of the groups

Morbidity score	Groups		Pearson's Chi-square	P-value
	control group count, (%)	experiment group count, (%)		

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0-8 score (normal)	10, (40%)	0, (0.0%)	12.500	0.001**
9-16 score (mild)	15, (60%)	25, (100%)		

The morbidity score was developed using morbidity related variables like respiratory tract infections, gastrointestinal disorders, infectious diseases, glands, and skin infections. The scoring was based on the number of recurrence for the last two months on 5 point scale of 4,3,2,1, and 0. The maximum possible score was 24 minimum score was 0. Terciles were taken as 0-8, 9-16, and 17-24 as normal, mild, and severe respectively.

Table.8 which shows the morbidity score of the control group and experimental group which indicated that 10 respondents in the control group had least morbidity score ranges from 0-8. Since morbidity is a negative condition the least scores are considered to be desirable. All the respondent of the experimental group and 15 respondents from the control group belonged to the morbidity score of 9-16 score. The statistical analysis showed significance between the groups with respect to morbidity score.

Table.9 Anthropometric measurements of the groups

Anthropometry	Groups	Mean	Std. Deviation	F-value	P- value
Height (cm)	Control	96.36	2.8705	4.571	0.038
	Experiment	95.04	1.1358		
Weight (kg)	control	14.612	0.6366	250.862	0.000
	Experiment	11.628	0.6943		
Head circumference (cm)	control	49	1.118	22.840	0.000
	Experiment	47.72	0.7371		
Chest circumference (cm)	control	48.4	1.5546	13.431	0.001
	Experiment	47.08	0.9092		
MUAC (cm)	control	14.44	0.3629	399.555	0.000
	Experiment	12.492	0.3252		

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WHO reference median values - Height –101.9 cm , Weight -15.9kg , Head .C – 49.2cm , Chest. C – 48.5 cm, MUAC - 16.1cm

Table.9 shows the mean anthropometric measurements of the control group and experimental group. It showed statistical significance between the groups with respect to their height, weight, head circumference, chest circumference, and MUAC measurements. The control group had better anthropometric measurements compared to the experimental group.

Table.10 Nutrient intake of the respondents 24 hour recall

Nutrients	Groups	Mean	Std. Deviation	p- value	Normal RDA
Calories (kcal)	Control	1189.200	55.1264	0.001	1350 calories
	Experiment	1134.200	56.5626		
Protein (g)	Control	14.660	0.5723	0.000	20.1 g
	Experiment	13.280	0.5220		
Iron (mg)	Control	10.68	0.453	0.202	13mg
	Experiment	10.52	0.420		
Calcium (mg)	Control	446.640	32.0831	0.503	600 mg
	Experiment	452.400	28.1780		
β-carotene (µg)	Control	2733.800	179.5903	0.056	3200 µg
	Experiment	2644.400	140.8332		
Vitamin C (mg)	Control	29.440	1.5297	0.011	40 mg
	Experiment	28.360	1.3503		

Table.10 shows the nutrient intake of the groups using 24 hour recalls survey for a period of 3 days. The control group had a better nutrient intake than the experimental group. The ANOVA analysis indicated that calories, protein, and vitamin C showed statistical significance.

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Table.11 Distribution of Anthropometric standards - pre and post intervention

Anthropometric variables		Height (cm)		Weight (kg)		Head. Circumference (cm)		Chest Circumference (cm)		MUAC (cm)	
	Groups	Control group	Expt. group	Control group	Expt. group	Control group	Expt. group	Control group	Expt. group	Control group	Expt. group
Pre intervention	Mean (A)	96.36	95.04	14.612	11.628	49.00	47.72	48.40	47.08	14.44	12.492
	Std. deviation	2.8705	1.1358	0.6443	0.69	1.118	0.7371	1.5546	0.9092	0.3629	0.3252
	p- value	0.038		0.000				0.001		0.000	
Post intervention	Mean (B)	97.040	95.920	15.160	13.312	49.00	47.72	49.000	48.60	14.92	13.36
	Std. deviation	2.669	1.115	0.5795	0.7167	1.118	0.7371	1.3844	0.763	0.3448	0.3391
Diff	(A) – (B)	0.68	0.88	0.548	1.684	0.00	0.00	0.6	1.52	0.48	0.868
	F-value	4.571	0.100	250.86	4.950			13.43	2.621	399.555	0.011
	p-value	0.753		0.031				0.112		0.917	

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Table.72, anthropometric measurements of the pre and post-intervention revealed that the intervention study was effective with an increased growth spurt in the experiment group. The p-values prior to intervention show that all the anthropometric measurements were significant in between the control and the experiment groups. After intervention, except for weight the p-value is greater than 0.05. It further implies that there was no statistical difference between these groups after intervention. In the case of weight the p-value changed from 0.000 to 0.031. The control group had a weight increase of 0.548 kg after 3 months, while the experiment group had an increased growth rate of 1.684 kg after supplementation. The difference in mean weights of the control and experiment group before intervention was 2.984 (14.612–11.628), but after intervention it become 1.848 (15.16–13.312). About 38 percent of weight gain occurred in the experiment group over control group on an average. These values points out that weight difference of children in between the groups get reduced. Thus it shows the supplementation provided some extent of improvement in the weight of children. More evidences was brought for this by computing the Z scores of these groups.

Similar kinds of studies were reported, supplemented with multi cereal based cookies for underweight children of 7-9 years and found a significant change in their nutritional status (Roseman et al. 2011, Eichler et al. 2012). Gibson (2005) suggested dietary diversification and modification, in conjunction with nutrition education, focus on improving the availability, access to, and utilization of foods with high nutrient content and bioavailability of micronutrients throughout the year. The strategies are designed to enhance the energy and nutrient density of cereal-based porridges; increase the production and consumption of micronutrient-dense foods (especially animal-source foods); incorporate enhancers of micronutrient absorption; and reduce the phytate content of cereals and legumes through germination, fermentation, and soaking. All these strategies can improve the food and nutrient intake pattern thereby reduce the macro and micronutrient deficiencies in preschool children.

Table.12 Z score summary – pre and post supplementation intervention

Control group				**Experiment group**			
Pre intervention		**Post intervention**		**Pre intervention**		**Post intervention**	
Weight (kg)	**WAZ**	**Weight (kg)**	**WAZ**	**Weight (kg)**	**WAZ**	**Weight (kg)**	**WAZ**
13.9	-1.33	14.5	-1.24	10.1	-3.16	12	-2.36
13.8	-1.39	14.5	-1.24	12	-2.39	13.9	-1.57
13.8	-1.39	14.3	-1.35	10.4	-2.97	12.1	-2.26
13.7	-1.19	14.4	-1.05	11.9	-2.21	13.8	-1.44
13.9	-1.08	14.4	-1.05	12.1	-2.33	13.8	-1.62
14.7	-0.65	15.3	-0.58	11.9	-1.89	13.4	-1.28
15.2	-0.46	15.7	-0.43	10	-2.97	11.5	-2.33
13.7	-1.14	14.4	-1	12	-2.29	13.7	-1.51

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15.4	0.11	15.7	0	12	-2.06	13.6	-1.38
14.5	-0.4	15.1	-0.33	12	-2.24	13.8	-1.39
15.4	-0.37	15.8	-0.41	10.2	-3.31	11.8	-2.54
15.5	-0.32	15.9	-0.36	12.1	-2.18	13.6	-1.5
15.2	-0.28	15.7	-0.31	12.3	-2.22	14	-1.51
15	-0.58	15.4	-0.62	12.3	-2.11	14.1	-1.3
14.9	-0.72	15.4	-0.68	12.3	-2.06	14	-1.28
14	-0.94	14.6	-0.87	12	-2	13.6	-1.32
14.5	-0.84	15.1	-0.77	11.5	-2.29	13.2	-1.53
14.2	-1	14.8	-0.92	11.4	-2.39	12.8	-1.79
15.5	-0.39	16	-0.37	12	-2.33	13.7	-1.58
13.9	-1.33	14.5	-1.24	12	-2.29	13.6	-1.57
14.4	-0.72	14.9	-0.72	11.6	-2.23	13.4	-1.42
15.3	-0.56	15.9	-0.49	11.7	-2.27	13.4	-1.58
15	-0.39	15.7	-0.31	11.8	-2.5	13.3	-1.89
14.9	-0.17	15.4	-0.17	11.6	-2.61	13.4	-1.84
15	-0.18	15.6	-0.12	11.5	-2.42	13.3	-1.69

Table.12 gives the z scores for weight for age of the children in the control and the experiment group respectively in pre and post intervention. The z scores of all the twenty five children of the control group were greater than -2SD of the standard population. Hence, before and after intervention they fall in the normal range. However the z scores of the experiment group children were lesser than -2SD (92%), before supplementation intervention so they lie in underweight category. But after supplementation, the z scores crosses above -2SD of the standard population (84%). It shows that after intervention only 16 percent children were lying in underweight category. This further implies that the supplementation of developed product gave a strong positive impact on the nutritional status of these children.

The same conclusion was drawing from the statistical analysis explained with the Table.11and 12. From the above two comparisons, it can be to concluded that proper supplementation with systematically developed supplementary foods for a continuous period of six months or more can enhance the nutritional status of children and thereby reduce the malnutrition.

CONCLUSION

The present study indicated that blending traditional supplementary food can improve the growth rate of underweight preschool children and help catch up and reach normal standards.

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