Comparison of Soy Enriched Diversified Foods and Foods Made from Traditional Cereals on Rural Children in the State of Jharkhand

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ABSTRACT

Food fortification has been emerged as an effective and economically viable strategy to address the micronutrient deficiency for people living in impoverish socio-economic condition. In India, problem of micronutrient deficiency among poor children can be addressed by this strategy. This study was an endeavor to test the effectiveness and viability of this strategy on selected children living in urban and semi-urban areas of the State of Jharkhand. This study was carried out on 60 purposively selected malnourished children of both sexes falling under the age range of 3 – 6 years. The Medical Council of India (MCI) defined parameters of malnourishment were applied while assessing the level of malnourishment among the selected children. The Body Index (Parameters) and a specially designed socio-demographic data sheet were applied for collecting the data. The selected 60 children were equally divided into two groups, and in these two groups two different kinds of diversified food items were given, viz., First group was provided the diversified food (Laddus) contained of soybean flour + maize flour + jaggary + clarified butter and second group was given laddus made up of Bengal gram flour + maize flour + jaggary + clarified butter. At the baseline physical assessment was done of the selected children and subsequently at 6-month and at the end of the study the body indices of the children were measured. No significant difference was noted between the two groups of Children in any body mass index at baseline, after 6 months and end of the study period. Both the diversified foods were found to be equally efficacious for the selected children's optimal growth and development.

Key words : *Soy; Micronutrients; Diversified foods; Malnutrition;*

Nutrition is an essential prerequisite of life, health and development across the entire life span. The term nutrition ascribes the availability of energy and nutrients to the body's cells as per the body requirements. Malnutrition has been appeared as the greatest threat to global public health. Malnutrition is the condition that keeping out of eating a diet in which certain nutrients are lacking, in excess (too high in intake), or in the wrong proportions. Nutritional disorders entail both under-nutrition and over-nutrition referred under a common term as "malnutrition" (*Garg et al., 2014*). Protein-energy malnutrition is one of the most pressing issues for the children and adolescents falling under the lower socio-economic class in the developing countries. Malnutrition also makes the suffering children susceptible to develop many life threatening infectious and non-infectious diseases and disorders. There are ample evidences that mild and moderate malnutrition pose far greater risks to child mortality than previously documented. These findings strongly suggest that interventions to prevent malnutrition in children will increase the overall effectiveness of child survival programs. Because malnutrition increases a child's risk of dying from many diseases-most prominently measles, pneumonia, and diarrhea-programs to prevent malnutrition can reduce mortality from several diseases simultaneously.

The purpose this study was to examine the efficacy of soy-augmented foods in fulfilling the micronutrient deficiency of the children belonging to lower socio-

economic status in the context of India. Some children belong to different age groups were selected purposively for the purpose of study. The age range of the children was 3-6 years. Findings of this study would let the common people as well as the policy makers, administrators, teachers and other important people important people aware about the efficacy of blended and improvised food items which contain locally available cheap sources like soya flour, maze flour, jaggary and clarified butter in dealing with children malnutrition. This study would show that if foods are simultaneously nutritious as well as savoury then it can attract the children. At the same time if those foods are made with locally available cheap food sources then it can sort the problem of malnutrition among the children at a considerable level.

METHODOLOGY

In the present study 60 malnourished children of both sexes falling within age range of 3 – 6 years residing in or around of the Bokaro city of Jharkhand state had been selected purposely. The Body Index (Parameters) was applied for measuring efficacy of diversified foods on the selected children. There are some parameters, which confirm that the particular child is suffering from malnutrition. These parameters are: Body Weight (kg.), Height (cm.), Circumference of Head (cm.), Circumference of Chest (cm.), Circumference of Mid Upper Arm (cm.). A specially designed socio-demographic data sheet was used for collecting the information related to the socio-demographic characteristics of the selected children. At the baseline sixty children belonging to the age range of 3 – 6 years were assessed through Body Index. Thereafter, those sixty children were randomly divided into two groups, viz., 30 children (15 boys and 15 girls) in each two groups. First group was provided food (Laddus made up of soybean flour + maize flour + jaggary + clarified butter), whereas, the Second group was provided food (Laddus made up of Bengal gram flour + maize flour + jaggary + clarified butter. At the baseline physical assessment was done of the selected children and subsequently at 6-month and at the end of the study the body indices of the children were measured. After data collection, statistical tests like 'descriptive statistics', 'Chi square test', and 'Independent Samples T Test (p)' were used to analyze the data. The software Statistical Package for Social sciences (SPSS 16) was used for data analysis.

RESULTS AND DISCUSSION

This Table 1 shows the age division of the selected children. Equal number of participants was employed in three age-groups of children. Children were divided into three age ranges, e.g., a) 3-4 yrs., b) 4-5 yrs. and c) 5-6 yrs. respectively.

Table 1. Comparison of age of the children of two groups (N=60)

Age group	Group-1[1](n=30)		Group-2[2] (n=30)	
	No.	%	No.	%
3-4 yr.	10	33.3	10	33.3
4-5 yr.	10	33.3	10	33.3
5-6 yr.	10	33.3	10	33.3

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

Table 2. Comparison of gender of the children of two groups (N=60)

Gender	Group-1[1](n=30)		Group-2[2] (n=30)	
	No.	%	No.	%
Boys	15	50.0	15	50.0
Girls	15	50.0	15	50.0

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

This Table 2 is showing the gender profile of the selected children. Children were equally divided into boys and girls.

Table 3. Comparison of family type of the children of two groups (N=60)

Family type	Group-1[1](n=30)		Group-2[2] (n=30)	
	No.	%	No.	%
Joint Family	10	33.3	10	33.3
Nuclear Family	10	33.3	10	33.3
Extended Family	10	33.3	10	33.3

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

Family background of the participants of the study is shown in this table. Equal numbers of children were selected from three types of families, viz., joint, nuclear and extended.

Table 4. Comparison of family size of the children of two groups (N=60)

Family size	Group-1[1] No. (%)	Group-2[2] No. (%)	df=4 χ^2	P
One Child + Parents	3 (10.0)	0 (0.0)	6.8	0.14[#]
Two Children + Parents	4 (13.3)	1 (3.3)		
Three Children + Parents	9 (30.0)	9 (30.0)		
More than Four Children + Parents + Others	6 (20.0)	12 (40.0)		
Children + Parents + Grand Parents	8 (26.7)	8 (26.7)		

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

This table is showing the comparative description of the family size of the two groups. No significant differences were noted between these two groups in family size.

Table 5. Socio-economic status of the families of the children of two groups (N=60)

Socio-Economic Status	Group-1[1] No. (%)	Group-2[2] No. (%)	df=4 χ^2	P
Lower SE Status	17 (56.66)	18 (60.0)	0.06	0.79[#]
Middle SE Status	13 (43.34)	12 (40.0)		

1- Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2- Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

This table is depicting thecomparison of the socio-economic background of the selected sixty children. Children were selected from lower and middle-socio-economic backgrounds. In either group no significant difference was seen with regards to their socio-economic status.

Table 6. Comparison of the children of two groups as per the history of immunization (N=60)

History of Immunization	Group-1[1] No. (%)	Group-2[2] No. (%)	df=4 χ^2	P
Children received minimal immunization	7 (23.3)	17 (56.6)	6.94	0.001[**]
Children received adequate immunization	23 (76.7)	13 (43.4)		

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

**Significant

Significant noted between these two groups of children in relation to history of immunization. Children receiving the laddus made with jaggary, clarified butter, maize flour and soybean flour have had the higher preponderance of adequate immunization history in comparison to children receiving the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour.

Table 7. Comparison of the children of two groups as per the history of post-natal complications (N=60)

History of Post-Natal Complication	Group-1[1] No. (%)	Group-2[2] No. (%)	df=4 χ^2	P
Children having Post-Natal Complication	0 (0.0)	1 (3.3)	1.01	0.31[#]
Children not having Post-Natal Complication	30 (100.0)	29 (96.7)		

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

This table is showing the comparison of two groups in relation to history of post-natal complications. In either group majority of the selected children did not have the history of post-natal complications.

Table 8. Comparison of growth of the children of two groups (Body Weight: in kg) (Independent Samples T Test) (N=60)

Weight level (in kg)	Group-1[1] Mean ± S.D.	Group-2[2] Mean ± S.D.	df=4 χ^2	P
Baseline Assessment	12.85 ± 1.41	12.79 ± 1.47	0.16	0.87[#]
After 6th Months Assessment	13.07 ± 1.33	13.00 ± 1.35	0.20	0.84[#]
At the End of the Study Period (12-Months)	13.33 ± 1.31	13.06 ± 1.33	0.79	0.43[#]

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

No significant difference was noted between the two groups of children in their body weight at baseline, after 6-months and at the end of study period (12-months).

Table 9 reveals that no significant difference was noted between the two groups of children in their height at baseline, after 6-months and at the end of study period (12-months).

Table 9. Comparison of growth of the children of two groups (Height: in cm) (Independent Samples T Test) (N=60)

Height level (in cm)	Group-1[1] Mean ± S.D.	Group-2[2] Mean ± S.D.	df=58 T value	P
Baseline Assessment	95.45 ± 4.66	95.36 ± 5.11	0.07	0.94#
After 6th Months Assessment	95.61 ± 4.70	95.40 ± 5.15	0.17	0.87#
At the End of the Study Period (12-Months)	96.23 ± 4.59	95.43 ± 5.16	0.63	0.53#

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

Table 10. Comparison of the growth of the children of two groups (Head circumference level) (Independent Samples T Test) (N=60)

Head Circumference	Group-1[1] Mean ± S.D.	Group-2[2] Mean ± S.D.	df=58 T value	P
Baseline Assessment	49.26 ± 1.17	49.11 ± 1.29	0.47	0.64#
After 6th Months Assessment	49.49 ± 1.17	49.25 ± 1.30	0.60	0.55#
At the End of the Study Period (12-Months)	49.71 ± 1.16	49.30 ± 1.30	1.29	0.20#

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

No significant difference was noted between the two groups of children in the growth of their head circumference at baseline, after 6-months and at the end of study period (12-months).

Table 11. Comparison of the growth of the children of two groups (Chest circumference level) (Independent Samples T Test) (N=60)

Chest Circumference	Group-1[1] Mean ± S.D.	Group-2[2] Mean ± S.D.	df=58 T value	P
Baseline Assessment	49.39 ± 0.82	49.37 ± 0.88	0.09	0.92#
After 6th Months Assessment	49.60 ± 0.81	49.46 ± 0.82	0.66	0.51#
At the End of the Study Period (12-Months)	49.80 ± 0.82	49.70 ± 0.76	0.49	0.62#

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

No significant difference was noted between the two groups of children in the growth of their chest circumference at baseline, after 6-months and at the end of study period (12-months).

Table 12. Comparison of the growth of the children of two groups (Mid- Upper Arm circumference) (Independent Samples T Test) (N=60)

Mid Upper-Arm Circumference	Group-1[1] Mean ± S.D.	Group-2[2] Mean ± S.D.	df=58 T value	P
Baseline Assessment	12.66 ± 0.53	12.70 ± 0.46	0.31	0.75#
After 6th Months Assessment	12.66 ± 0.54	12.70 ± 0.46	0.31	0.76#
At the End of the Study Period (12-Months)	13.11 ± 0.41	12.99 ± 0.43	1.11	0.27#

1. Children received the laddus made with jaggary, clarified butter, maize flour and soybean flour
2. Children received the laddus made with jaggary, clarified butter, maize flour and Bengal gram flour

#Not significant

No significant difference was noted between the two groups of children in the growth of their mid-upper arm circumference at baseline, after 6-months and at the end of study period (12-months).

In this study, 60 children were given two kind of diversified foods, a) 'laddu', e.g. a local sweetmeat made with Bengal gram flour, maize flour, jaggary and clarified butter and b) 'laddu' made with soybean flour, maize flour, jaggary and clarified butter. Children of either group were given these two kinds of modified foods separately along with their normal staple foods. It was seen that both these two types of modified/diversified foods were equally efficacious in assisting growth and development of these children. Both foods ((a) 'laddu', e.g. a local sweetmeat made with Bengal gram flour, maize flour, jaggary and clarified butter and b) 'laddu' made with soybean flour, maize flour, jaggary and clarified butter)) were observed to have equal beneficial impact on their physical growth (Indices of Body Mass). In case of the parameters taken in this study to measure the changes in the physical structure of the four groups of children, i.e. height, weight, head circumference, chest circumference and mid upper arm circumference the children of either have been observed to have equal rates of development in all the three assessments, i.e. baseline (at the time of the starting of the study) assessment, assessment after 6 months and assessment after 12 months (at the end of the study period). Though,

no statistically significant difference was noted, but modified food (laddus) containing soybean flour has the higher potentiality to influence the growth and development of the children to positive direction. Fortification as well as diversification of foods was found to be a viable as well as economically attractive strategy to deal with micronutrient deficiencies of the people, especially children having poor socio-economic background. Many studies and research works done previously showed that food-based strategy; especially fortification of existing food items with essential micronutrients can be a good option to overpower the problem of malnutrition in vulnerable segments of population, e.g. children (*Brown et al., 2007; Beinner et al., 2010; Chen et al., 2011; Abizari et al., 2012*). Fortification programmes have become a choice of the day to add nutrients to commonly consumed foods. Iodine fortification of salt is perhaps the best-known fortification programme globally. This way, few countries also tried to explore micronutrient rich foods which are locally available, cheap and are augmenting those food items with popular staple foods like cereals and grains. In Thailand, the government adopted almost same kind of strategy to reduce malnutrition among children and found very good results. Thailand government provided 450 kcal and 12-14 grams of protein supplementation per 100 gram of food which included pulses and fats in addition to cereals to children and those children were seen to have reduced problem related to malnutrition (*Heaver & Kachondam, 2002*).

CONCLUSION

Present study has showed that adjunctive use of diversified foods can be a good strategy to deal with micronutrient deficiency of the children belonging to lower and middle socio-economic statuses. Augmentation of protein and other essential nutrients rich foods made from soybeans, grams and lentils with staple foods has been emerged as a solution to malnutrition to people belong to poorer country and because of its sturdiness and diverse ability. This kind of strategy can easily be inflicted to people because of its cultural assonance. Such kind of improvised foods can be presented to children as savoury foods because of their increased attractiveness quality and taste. This study had shown an option to reduce micronutrient deficiency among children by mixing soy flour with existing cereals and grains and the process was found to be very easy to adopt and even poorer families can also afford this strategy. Food items made from sources soybean, maize flour, Bengal gram and other lentils can be made popular in society. Common people are to be given information on making attractive and tasty foods from locally available nutritious lentils and cereals.

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