Original Article

Effect of quality and quantity of diet on nutritional status of under-five children residing in the rural area: A longitudinal study

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Abstract

Introduction: Variety and adequacy of intake of food are required to meet the nutritional needs of the children. Due to poverty/illiteracy, poor families depend on a single food group that is, cereals. Due to the pandemic also, the nutrition of the growing children is affected. **Objective:** To know the effect of quantity and quality of diet on the nutritional status of under-five children. **Methodology:** This study had 270 children aged between 1 and 4 years registered at Anganwadi as study participants. Information on sociodemographic variables, quantity of calories and proteins consumed, quality of diet, and anthropometry of children was collected. Percentages and paired *t*-tests were used to find the difference between nutritional status and diet at different intervals, which was found to be statistically significant ($P < 0.05$). **Results:** In our study, we found that as the quantity and quality of diet improved nutritional status, especially weight for age, body mass index (BMI) for age Z score also improved. There was a significant difference between calories consumed at the baseline, 6 months and 1 year with $P < 0.05$. Protein intake was significant between baseline and six months with $P < 0.005$. **Conclusion:** Our study found a high percentage of undernutrition and wasting in the under-five population when diet was not sufficient in quality and quantity. As the quality and quantity of diet improved nutritional status also improved.

Keywords: Children, diet diversity, diet serving score, wasting, under-five, undernutrition

Introduction

Diet is an important factor in achieving adequate growth and development in children. Diet diversity with nutrient-rich foods is important to meet the dietary needs that help in normal growth during their initial years of life.[1] The study of the growth velocity of children and its association with diet diversity indicators helps policymakers, pediatricians, and family physicians to start corrective measures. Also, based on the food grains grown locally, and staple food consumed some modifications in cooking practices can be advised to the mother.[2]

As per the National Family Health Survey 5 (NFHS) data, only one-fifth of non-breastfed children aged between 6 and 23 months received adequate diet.[3] Despite the Integrated and Child Development Programme, malnutrition is a major public health problem among under-five children.[4]

So, longitudinal studies of growth and its relation with the quantity and quality of diet throw more light on the process of growth, which helps policymakers to implement required recommendations. Hence, the present study was planned to know

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the effect of quality and quantity of diet on the nutritional status of under-five children.

Materials and Methods

Study Design: Longitudinal study

Source of Data: Rural field practice area of the Department of Community Medicine

Data Collection Period: August 2021 to August 2022

Study Population: Children (1-4 years)

Sample size was calculated using $n = Z\alpha^2\ pq/d^2$

considering 66.9% of children consuming low-diet diversity,[5] at a 95% confidence interval, with 6% allowable error and 20% attrition

Sample size = 270

Sampling technique: Out of five sub-centers, randomly two sub-centers were selected.

A list of children aged between 1 and 4 years registered at selected Anganwadi (AW) was obtained; randomly AWs under the selected sub-centers were selected until the required sample size was reached, that is, 270 children, six Anganwadis were included from two sub-centres.

Ethical clearance: Obtained from the Institutional Ethics Committee letter no. EC/21-22/019 dated 29/07/2021.

Inclusion criterion

All children aged between 1 and 4 years residing in the study area and registered in Anganwadi.

Exclusion

Children with diseases such as type 1 diabetes mellitus, congenital heart diseases, cretinism (already diagnosed cases), and differently-abled children,

Data collection procedure

A predesigned proforma was prepared and after obtaining the consent of parents, the data were collected on sociodemographic variables, anthropometry of children, and diet of children. Length of children above 2 years was measured using a stadiometer and for those who were less than 2 years using an infantometer; weight was measured using a Salter scale. The nutritional status of under-five children was assessed using the Epi Anthro software and a "Z" score was used to know the nutritional status of children (weight for age, height for age, weight for height, body mass index [BMI] for age) were calculated.[6] Longitudinal data were collected at the interval of 6 months and 1 year.

Information regarding the 24-h recall method to know the adequacy of diet in terms of calories and proteins consumed was performed on two occasions and a means score was considered. To know the quality of diet, food variety score, and diet diversity (food groups consumed daily, once in 3–7 days and once in fortnight/month) performed for these 12 food groups were considered as per the Food and Agriculture Organization classification,[7] to identify diet serving score frequency of serving the food was also collected. This was performed at the beginning of the study at 6-month intervals and at 1-year intervals to know the pattern of diet and its effect on the nutritional status of children.

Calculation of diet diversity indicator

Food variety score

- Calculation of the Food Variety Score was performed by considering individual food items consumed without considering the group of food.
- Diet diversity score (DDS)

Dietary Diversity Score	12-food group
Low	≤ 4
Medium	5-8
High	9-12

Dietary Serving Score (DSS)

- The dietary serving score was calculated as follows[8]

Food groups	Number of servings recommended	Assigned score
Cereals/roots	Four	Four
Vegetables	Two	Four
Fruits	Two	Four
Legume/lentil	One	Two
Meat/fish/egg	One	Two
Milk/dairy products	Two	Four
Total	Twelve	Twenty

Statistical analysis

Data were coded and entered in Microsoft Excel and data were analyzed using the Co Guide statistics software, V.1.01. BDSS Corp. Released 2020. Version 1.0, India: BDSS Corp. Descriptive analysis was carried out using percentages and a paired *t*-test was used. The level of significance of < 0.05 was considered.

Results

In this study, among 270 participants, 137 (50.74%) were boys and 133 (49.26%) were girls. The mean age of participants was 29.06 ± 10.43 years. Also, 105 (38.89%) of them were 12–24 months, 81 (30%) were 25–36 months, and 84% (31.11%) were more than 37 months. In the present study, 27.78% of the participant's father was illiterate. Also, 18.52% were farmers, 46.67% were laborers, and 20.37% of mothers were illiterate. Next, 13.38% participant's mothers were farmers, 29.0% were laborers, and 53.16% were homemakers [Table 1].

Table 1: Descriptive analysis of sociodemographic parameters in the study population (*n*=270)

Socio demographic variables	Number	Percentage
Age groups		
13-24 months	105	38.89%
25-36 months	81	30.00%
37-48 months	84	31.11%
Gender		
Male	137	50.74%
Female	133	49.26%
Religion		
Hindu/Others	242	89.63%
Muslim	28	10.37%
Type of the family		
Nuclear	122	45.18%
Joint	148	54.81%
Socio economic class		
Class I-III	53	19.63%
Class IV-V	217	80.37%
	Education of father	**Education of mother**
Illiterate/read and write	75 (27.78%)	93 (34.45%)
Primary	34 (12.59%)	35 (12.96%)
Secondary and above	161 (59.63%)	142 (52.59%)
	Occupation of father	**Occupation of mother**
Farmer	50 (18.52%)	36 (13.38%)
Daily wage Labour	127 (46.67%)	78 (29.00%)
Self-employment	55 (20.37%)	1 (0.37%)
Government employee/private employee	38 (14.08%)	11 (4.09%)
Home maker	-	143 (53.16%)

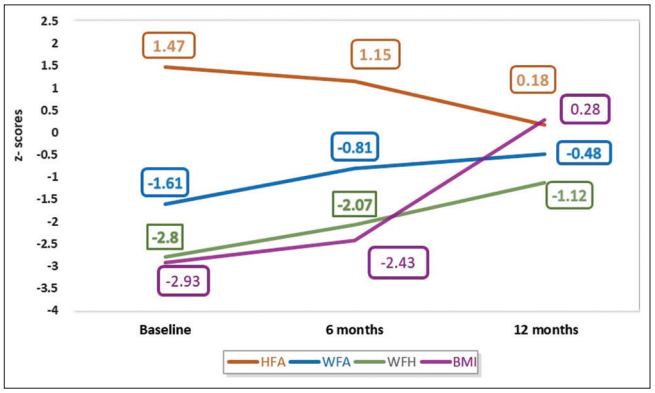
In the present study, weight for age Z score was <-2 in 29.3% of children, which reduced to 11.9% after 6 months and 4.1% at 12 months. The difference was statistically significant ($P < 0.001$). Height for age Z score was <-3 in 1.5% of children in the beginning and at the end of 6 months and 3.7% at the end of 12 months. The difference was statistically significant ($P < 0.001$). Weight for height and BMI Z score showed the maximum difference between beginning, 6 months, and 12 months [Table 2].

This study showed that the mean Z score for weight for age, weight for height and BMI increased from the baseline to 6 months to 1 year. This difference was statistically significant [Table 3].

In this study, it was observed that the mean height for age decreased at 6 months and 1 year as compared to the baseline mean value, whereas the weight for age, weight for height and BMI Z scores improved at 6 months and 12 months [Graph 1].

In this study, it was observed that the mean calorie intake improved at 6 months and also at 12 months as compared to the baseline mean value, whereas the protein intake improved from the baseline to 6 months and almost remained the same at 12 months [Graph 2].

In this study, it was observed that the mean diet serving score, food variety score, and diet diversity score improved at 6 months and 12 months as compared to the baseline mean value [Graph 3].



Graph 1: Comparison (mean) of HFA, WFA, WFH and BMI across different time points

In this study, calories consumed by children improved at 6 months and also at 1 year, protein consumption improved at 6 months and remained almost the same at the end of 1 year. Diet diversity, food variety and diet serving score also improved from the baseline to 6 months and 1 year [Table 4, Graphs 4 and 5].

Out of the total, 100% of children consumed cereals, 92% milk, 87% pulses, 69% green leafy vegetables, and 19% vegetables daily. Also, 70% consumed fruits once a week, 46% consumed eggs weekly, and 4% consumed meat once a fortnight. More children started consuming other vegetables, fruits, sweets, and eggs as compared to the baseline either daily or alternate days [Graphs 4 and 5].

Table 2: Comparison of z scores for WAZ, HAZ, BMI at baseline, 6 months and 1 year

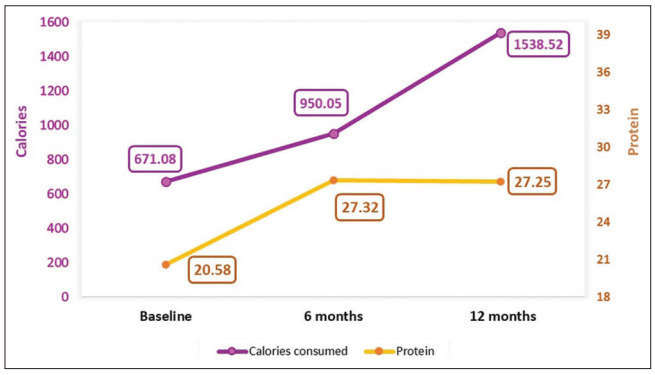
Variables	Baseline (*n*=270)	6 months (*n*=270)	12 months (*n*=270)	*P*
Weight for age group				
<-2 (underweight)	79 (29.3%)	32 (11.9%)	11 (4.1%)	<0.001
-2 to 2 normal	191 (70.7%)	238 (88.1%)	259 (95.9%)	
Height for age group				
<-3 (stunted)	4 (1.5%)	4 (1.5%)	10 (3.7%)	<0.001
-2 to 2 (normal)	175 (64.8%)	211 (78.1%)	247 (91.5%)	
≥3 (tall)	91 (33.7%)	55 (20.4%)	13 (4.8%)	
Weight for height group				
≤-3 (wasted)	227 (84.1%)	106 (39.3%)	21 (7.8%)	<0.001
-2 to 2 (normal)	43 (15.9%)	164 (60.7%)	249 (92.2%)	
BMI status group				
≤-3 (thin)	256 (94.8%)	153 (56.7%)	7 (2.6%)	<0.001
-2 to 2 (normal)	14 (5.2%)	117 (43.3%)	256 (94.8%)	
≥3 (over weight)	0 (0%)	0 (0%)	7 (2.6%)	

Table 3: Comparison of nutritional status of children (Z score) at baseline, 6 months and 1 year

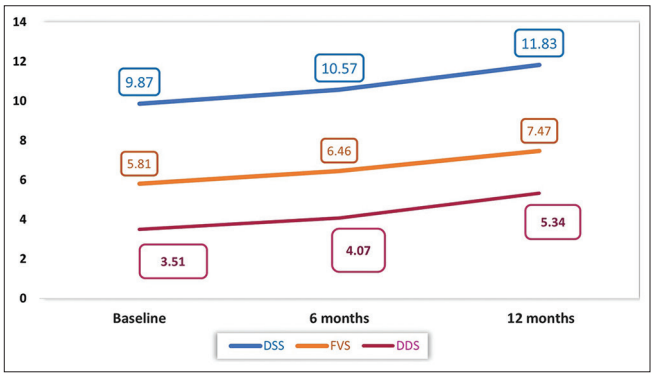
Anthropometry	Baseline	6 months	12 months	*P*		
				Baseline vs. 6 months	Baseline vs. 12 months	6 months vs. 12 months
Weight for age Z score	-1.61±1.21	-0.81±1.25	-0.48±1.06	<0.001	<0.001	<0.001
Height for age Z score	1.47±1.51	1.15±1.45	0.18±1.36	<0.001	<0.001	<0.001
Weight for height Z score	-2.8±0.52	-2.07±0.93	-1.12±0.97	<0.001	<0.001	<0.001
BMI Z score	-2.93±0.3	-2.43±0.76	0.28±1.2	<0.001	<0.001	<0.001

Table 4: Comparison of quality and quantity of diet at baseline, 6 months and 1 year

Quality and quantity-diet	Baseline	6 months	12 months	*P*		
				Baseline vs. 6 months	Baseline vs. 12 months	6 months vs. 12 months
Total calories consumed	671.08±154.91	950.05±141.7	1538.52±165.78	<0.001	<0.001	<0.001
Total protein consumed	20.58±5.5	27.32±5.59	27.25±5.77	<0.001	<0.001	0.954
FVS	5.81±1.53	6.46±1.45	7.47±1.37	<0.001	<0.001	<0.001
DDS	3.51±0.69	4.07±0.83	5.34±0.9	<0.001	<0.001	<0.001
DSS	9.87±1.65	10.57±1.62	11.83±1.67	<0.001	<0.001	<0.001



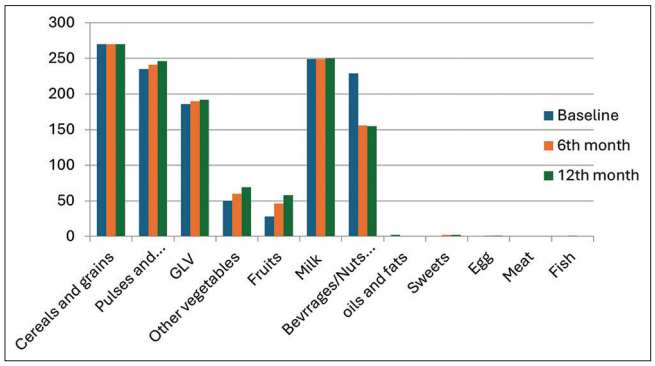
Graph 2: Comparison of calories and proteins consumed across different time points



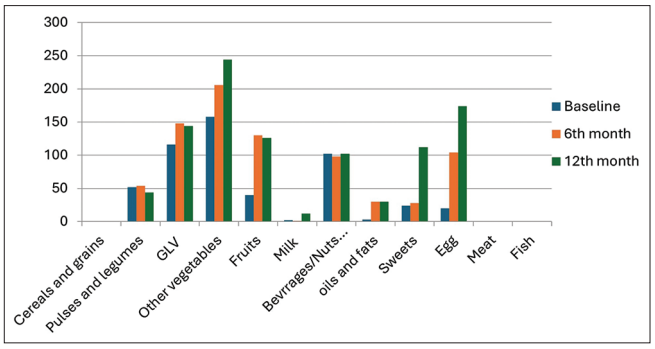
Graph 3: Comparison of DSS, FVS, and DDS across different time points

Discussion

Similar to the NFHS-5 data, this study also showed that undernutrition was about 30%,[3] stunting was less as compared to the NFHS data, and more children had a height higher than normal, the reason for the difference could be because of genetic factors that might have decided the height of children and as chronic malnutrition affects height, not acute malnutrition. Because of COVID-19, study subjects faced acute malnutrition. Because of the higher prevalence of children whose height was more than normal and undernutrition being 30%, wasting and BMI were more compared to the NFHS 5 data for India and Karnataka. Another study showed that underweight was more



Graph 4: Daily consumptions of food groups at the baseline, 6th month, and 12th month



Graph 5: Alternate day consumptions of food groups at the baseline, 6th month, and 12th month

in this study (38.3%) and the rate of stunting (41.3%) was more than the NFHS 5 data for India. In this study, wasting was less that is, 18.4%, the reason for this finding could be because more children were stunted than wasted. Similar findings were found in other studies.[9-12] A study performed in Rohtak showed the prevalence of wasting was 13.8%, stunting was 31.2%, and underweight was 21.4%. The proportion of wasting was higher among boys.[13] As the prevalence of stunting, undernutrition and wasting vary depending on various underlying causes, there is a need for specific action for its prevention.

A study performed in Nigeria showed that stunted children were more likely to have a low Diet Diversity Score.[14] A study performed in South Africa showed that height for age had significant positive correlations with the Food Variety Score and Diet Diversity Score.[15] According to a study, a positive association was found between a child's age and DDS that is, older children met better Mean Diet Diversity as compared to young children.[5] The present study showed that when diet was deficient in quantity in the form of consumption of calories, and proteins, and low in quality that is FVS, DDS less than 4 and DSS less than 10, weight got affected more than height.

A study performed in north-central Ethiopia showed that a positive and generally linear trend in the mean HAZ is observed as DDI increased indicating that low dietary diversity increases the risk of undernutrition.[16] Another study performed in Ghana showed that animal-source food scores were positively correlated with children's WHZ.[17] Similar findings were observed in a study performed in Tobago, Woreda, and California.[1,8,18] Our study showed that by increasing the quantity and quality of diet, a change in weight was observed; hence, the prevalence of undernutrition decreased over a period of 1 year. Height did not change like weight; the reason could be that in the beginning of the study, not many children were stunted, the reason could be acute malnutrition during the COVID-19 period. Anganwadis provided raw ration to the families of children, and later started preparing energy-dense foods for children after they received permission to open the Anganwadis. Hence, catch-up growth was observed in our study participants as far as weight was concerned when their diet was improved in quantity and quality.

In a study performed on Filipinos showed that as far as diet diversity is concerned, the consumption of cereals was 100%, oil/fat was 97%, and tubers was 88.71%.[19] Various studies have shown that more people prefer food with high protein and energy compared to vegetables and fruits and their low consumption leads to micronutrient deficiency.[20,21] The present study showed that at the baseline, more children consumed cereals, pulses, milk, and nuts (oil) on a daily basis. The consumption of foods of animal origin, fruits, and vegetables other than green leafy was less.

In this study, the mean difference in food variety score between the baseline and at the end of 12 months was 1.66, the difference in diet diversity score was 1.83, and the difference in dietary serving score was 1.96. The dietary diversity score should be more than 4 and the dietary serving score more than 10 for the optimum growth of under-five children.[8] As the mean DDS was less than 4 at the beginning of our study and the mean DSS was less than 10, many children had lesser WAZ, BAZ scores. As FVS, DDS and DSS improved, total calories and proteins consumed also increased and hence the nutritional status of under-five children also improved. At a given point, the growth of a child may be normal or better than standard reference values but the velocity of growth may be affected if an adequate diet is not provided. Similarly, a malnourished child may grow well if adequate nutrition is provided. A monotonous diet affects the nutritional status of under-five children.[22] Though many factors are responsible for the growth of children, diet plays an important role in maintaining optimum growth.

The present study is a longitudinal study that considers the assessment of quality as well as the quantity of diet and its effect on the nutritional status of under-five children, where the follow-up of diet and anthropometry are performed. Many studies have been performed taking into consideration either the quality or quantity of the diet using a cross-sectional design.

Conclusion

Our study showed that during the COVID lockdown period as Anganwadis were closed, raw food was given to the families of children. It affected the quantity and quality of diet consumed by

children. This acute shortage of food during the pandemic had an effect on weight more than the height of children. Many parents' income was based on daily wages, affecting the economic status of the family. In the present study, one-third of the participant's height was more than 2 standard deviation (SD) and one-third of participants had weight less than -2 SD; hence, the weight for height and BMI for age was more affected among under-five children. An increase in the quality and quantity of diet provided by Anganwadis under the Integrated Child Development Services Programme helped in increasing the weight of the children compared to height. Hence, Z scores of weight for age, weight for height and BMI scores also improved over a period of 1 year.

Recommendations

The diet of children should be improved by increasing food variety at home and Anganwadi which increases the interest of children in eating.

A diet diversity score of more than 4, with the inclusion of fruits and vegetables, meets the micronutrient deficiency in the diet. Food groups containing animal sources meet the requirement of essential amino acids and good-quality proteins. Hence, nutrition education of mothers and Anganwadi workers regarding diet diversity is very important.

As per the recommendations by the Food and Agriculture Organization, the number of food servings should be 12, and the diet serving score should be 20 for optimum growth of children, which ensures the adequacy of quantity (calories and proteins) and the quality of the diet. So, training of Anganwadi workers and mothers will help in providing an appropriate diet for children.

As the present study was performed during the COVID pandemic, providing raw ration to the family did not help to provide adequate nutrition to children. Programme managers can use different approaches to supply adequate diets to the vulnerable population during any emergency.

Limitations

As it was a longitudinal study, children were selected from six Anganwadis belonging to two sub-centres only.

Bias could have occurred while collecting data on the nutrition of children.

Genetics and sociodemographic variables also play an important role in determining the nutritional status of children along with nutrition; the present study emphasized the quality and quantity of diet in determining the nutritional status of children.

As the study was performed during the COVID pandemic, Anganwadis could not provide cooked food to children until they started functioning.

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Conflicts of interest

There are no conflicts of interest.

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