

Food Intake and Energy Protein Adequacy of Children from an Urban Slum in Mysore, India - a Qualitative Analysis

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ABSTRACT

The objective of the investigation was to analyse energy protein adequacy of the diets of Indian children residing in an urban slum. The subjects numbering 271 between the ages of 4-14 years resided in a slum in Mysore city in South India. Nutritional status of children and mothers were determined by standard procedures. Background information was obtained using questionnaire method. Dietary intake data was collected using the 24-hour recall method and analysed for adequacy of food intake, energy protein ratio of diet, sources of protein in diet and associated factors. Results indicate that intake of cereals and pulses is inadequate in younger children but improves with age. Intake of other vegetables is higher than the recommended levels, but that of green leafy vegetables is extremely low. Consumption of fats, oils and milk is very low while protein is derived from plant sources for the majority of the children. Only 22% of children enjoyed a diet adequate in protein and calories. Protein calorie adequacy is influenced by age and gender of children and significantly by literacy or economic status of mothers. Mother's nutritional status influenced protein energy adequacy of diets significantly. Thus, intervention efforts should not only aim at improving the socio-economic conditions of slum dwellers in general, but should also address nutritional needs of mothers and children.

INTRODUCTION

Despite considerable improvements in the quality of life and health status, the levels of child malnutrition in India is very high - more than half the young children show moderate to a severe degree of malnutrition. Chronic energy deficiency (CED) in a similar proportion of adults suggest perpetuation of childhood malnutrition into adulthood. The consequence and effect of chronic malnutrition is such that it is inter-generational beginning with mothers and their young children, and account for a large

proportion of child deaths, mental disability and less productivity and earning potential among citizens (Hunt & Quibria 1999; UNICEF 1990; RETA, 1997). The reports of the recent nationwide National Family Health Survey III indicate that 36.4% of urban Indian children are underweight and 19.8% of urban women suffer CED; most of these belong to the impoverished sections of society (NFHS, 2007).

Diet is one of the prime determinants of health and nutritional status. An inadequate diet, poor in both quality and quantity has been one of the reasons for high levels of

malnutrition in children. Dietary surveys are therefore one of the essential components of nutritional assessment. Assessing dietary adequacy in terms of quality and quantity is equally important. Nutrient energy ratios have been used as indices of dietary quality in relation to several specific nutrients and to express nutrient goals, which in turn are the basis for dietary guidelines. It is believed that if a diet is eaten in amounts to satisfy energy requirements, it may be able to provide all other nutrients in sufficient amounts. Thus protein energy ratio is often used to describe the protein quality of a diet with the ratio being expressed as a percentage of protein energy in the diet. The most important application of protein energy ratio is to evaluate if the diet has a proportion of dietary proteins that may prevent the occurrence of protein deficiency. This also serves as one of the descriptors of overall dietary quality (Torun *et al.*, 1991). While there is sufficient information available on the dietary intake of rural and urban populations in general, data is scarce on specific population groups such as those from urban slums. Urban slums cannot be equated to rural areas though the families from both areas are generally from a low socio-economic background. Hence, the objective of the present study was to analyse the energy protein adequacy of diets and associated factors of Indian children residing in an urban slum. The results are also compared with data available for rural Indian children.

METHODOLOGY

The study area selected was an urban slum by the name of Ghousianagar in the city of Mysore with a predominantly Muslim population. A sample of 271 children between the age of 4-14 years attending school and a preschool centre located in the slum and their mothers were enrolled in the study on a voluntary basis. Informed consent was obtained from all the families before

enrolling the children for the study. Permission was obtained from school authorities who assisted in enrolling children for the study. The study was approved by the appropriate research monitoring committee of the University of Mysore.

Data collection was cross-sectional in nature. Background data from mothers on economic and literary status was collected with the help of questionnaires for the purpose of analysis of associated factors. Food expenditure was considered as the index of economic status as the majority of the families belonged to the labour class and their monthly income was not stable (Lakshmi *et al.*, 2005). A large percentage of the family income was spent on food. Based on the food expenditure, the economic status of the families was categorized into three categories: level 1 (low), level 2 (medium) and level 3 (high). Based on the literacy levels or years of formal schooling received, the mothers were categorized into level 0 (no literacy), level 1 (with 5-7 years of schooling) and level 2 (with 8-10 years of schooling).

Nutritional status of children and mothers

Children were assessed for age, weight and height. Exact age was arrived at by referring to the date of birth maintained in the school and preschool records. Weights of the children were recorded using an electronic balance (Essae Digi Scale, Model DI -20) to the nearest 0.1 kg by standard techniques. Heights of all the children were recorded with the aid of a non-stretchable fibreglass tape fixed to a straight wall to the nearest 1.0 mm on enrollment. Weights and heights of the children were compared with the 50th percentile of NCHS standards (WHO, 1983) and the degree of nutritional status was computed using 'Z' scores or standard deviation classification as normal (Median to -1sd), mild (-1sd to -2sd), moderate (-2sd to -3sd) and severe (<-3sd) (Rao & Vijayaraghavan, 1996).

Weights and heights of the mothers of the selected children were also recorded and body mass index was computed. The nutritional status of mothers was coded as per the classification of BMI suggested for Asian populations (IOTF/WHO, 2000).

Diet survey

The food intake of children was determined using the 24-hour recall method. A pilot study was conducted to collect information on different types of food consumed in the area and these were standardised in the laboratory for cooked weights and nutritional composition. Mothers of the children were interviewed to obtain information on the food, beverages and snacks consumed by the children in the preceding 24 hours. These were recorded using a set of cups (75-250ml), ladles and tumblers that were pre-standardised in the laboratory. The diet survey data for the entire study population was collected on two consecutive days in the middle of the week and averaged to obtain information on the regular diet pattern of the selected subjects. The food consumed was converted into raw food using the values standardised in the laboratory and percent adequacy of food intake was calculated based on desirable intake as given by ICMR (1999). The protein intake and calorie protein adequacy was computed using food composition tables and recommended dietary allowances for Indians (Gopalan *et al.*, 1996; ICMR, 1990). The energy protein ratio was expressed as percent of calories derived from protein in relation to total calories. Energy protein adequacy was analysed for association with various child and maternal factors.

The data was analysed statistically to determine the significance of various associative factors with the energy protein adequacy of the diet. The determinants were nutritional status, age and sex of children and mother's nutritional status, literacy and economic status. The level of significance used was $p < 0.05$. The statistical packages

used were SPSS version 10.0 and the MINITAB statistical software.

RESULTS AND DISCUSSION

Adequacy of food intake

Percent adequacy of food intake of the boys and girls assessed by the 24-hour recall method is presented in Table 1. Available data for rural children of Karnataka state is also presented for the purpose of comparison and to bring out the differences between children from an urban slum and a rural area (NNMB, 2002). The latter was also based on the 24-hour recall method. The consumption pattern varied depending on the age and gender of the children. The percent adequacy of cereals varied between 80-88% in 4-9-year-old children. However, between 10-14 years, it was within the desirable range for girls but inadequate for boys indicating increased requirements for boys during the secondary growth spurt. In contrast, a slightly better adequacy of cereal intake was observed in the rural counterparts. In the case of 10-14 year old girls, it was much higher than the requirements indicating an excessive intake of cereals in the rural population. The intake of pulses showed a linear increase from 4 to 14 years among all slum children wherein percentage adequacy improved from 64-99%. However, intake of pulses was low in rural children.

Intake of green leafy vegetables was found to be 19-46% of requirement among all children, but was higher than the intake for rural children. The intake of other vegetables was found to be very good in slum children, though the consumption of roots and tubers varied to a large extent. On the whole, they consumed more vegetables than their rural counterparts. The intake of all vegetables was found to be very low in rural children of all age groups whereas it was several times higher in children residing in slums (NNMB, 2002). One of the possible reasons for such a difference could be the seasonal variations observed in vegetable

Table 1. Percent adequacy of food intake of children in relation to age and in comparison with rural children

Foods	Slum children - Present study								Rural children*					
	Age in years								Age in years					
	4-6		7-9		10-12		13-14		4-6	7-9	10-12	13-14		
	M	F	M	F	M	F	M	F	M&F	M&F	M	F	M	F
Cereals	80 (210)	85 (210)	88 (270)	87 (270)	91 (330)	109 (270)	90 (420)	101 (300)	96	98	98	122	97	134
Pulses	64 (45)	68 (45)	77 (60)	71 (60)	88 (60)	84 (60)	99 (60)	98 (60)	47	47	50	47	57	58
Green leafy vegetables	35 (50)	46 (50)	31 (100)	24 (100)	32 (100)	19 (100)	29 (100)	30 (100)	8	8	11	8	10	12
Other vegetables	161 (50)	140 (50)	83 (100)	127 (100)	119 (100)	145 (100)	114 (100)	134 (100)	28	16	22	14	23	20
Roots & tubers	78 (100)	58 (100)	91 (100)	104 (100)	116 (100)	98 (100)	80 (200)	86 (100)	23	27	28	30	42	33
Fats & Oils	58 (25)	56 (25)	85 (25)	97 (25)	102 (25)	98 (25)	86 (25)	91 (25)	24	28	40	32	44	40
Milk & milk products	8 (100)	7 (100)	5 (100)	6 (100)	5 (100)	4 (100)	5 (100)	6 (100)	13	12	13	13	17	14
Sugar & Jaggery	16 (30)	18 (30)	22 (30)	11 (30)	13 (35)	9 (30)	11 (35)	10 (30)	67	67	63	77	60	77

M: Male, F: Female.

* Data computed from NNMB National survey report of rural children (2000).

Figures in parenthesis indicate the desirable daily intake of foods in grams as per ICMR guidelines (1999).

Table 2. Sources of protein in diets of children (n=271)

Percent of children	Plant proteins (as % of total protein)	Animal proteins (as % of total protein)
20	100	-
28	80-90	10-20
18	60-80	20-40
22	40-60	40-60
12	≤ 40	≥ 60

intake in the rural areas (Lakshmi *et al.*, 2001). Average intake of roots and tubers shifted from inadequacy to near and above adequacy with advancing age. The intake of roots and tubers of the study group was found to be much higher than that reported for rural children from the 7-14 year group (NNMB, 2002). This could be due to

availability of seasonal vegetables at their door step through local vendors at reasonable costs.

Similarly the consumption of fats and oils was found to be better in slum children. This could be due to the varieties of food eaten and the occasional consumption of snacks in urban areas. Intake of fat increased

from 4-9 years among girls and up to 12 years among boys and decreased thereafter. The intake was found to be adequate among the 10-12 year group but highly inadequate among the 4-6 year group. Intake of a wide range of food items among older children could have resulted in a higher intake than for their younger counterparts. Intake of visible fat for rural children was found to be highly inadequate and no change was evident in relation to age as observed in the children from the slum areas.

Consumption of milk and milk products was negligible among all children irrespective of age and sex. As mentioned earlier, milk added to coffee/tea was the only source of milk consumed by these families. Though consumption of milk was low among rural children of low income groups, it was two times higher than that for the slum children of the same age group (NNMB, 2002). Hence the contribution of milk and its products to the calcium content of these children is negligible.

Sugar and jaggery, energy dense components were consumed in very small quantities either in coffee/tea in the regular menu and sweet preparations were reported to be restricted to festivals/other occasions. A similar trend was evident in the sugar intake of rural children irrespective of sex and age (NNMB, 2002). Though sugar and jaggery are high calorie sources, their contribution to the calorie content in these children's diet is limited.

Besides these, children also consumed 30-40 g/day of meat and fish on an average. The low intake of meat and meat products cannot be overlooked because they are a rich and superior source of many nutrients. Intake of meat products in the study children was found to be higher than that reported for the rural children.

Coconut was used very frequently in cooking. Average intake of coconut (5-6g/day) was found to increase with age, which again can be attributed to the use of a wide range of food and family diet with age.

Though coconut is not considered an essential food ingredient, it is a rich source of fat and contributes notably to the total calorie pool of diets.

The visible difference in dietary pattern of children from urban slums and rural areas can be attributed to the two dimensions of food security, namely availability and accessibility of food (Gross *et al.*, 2000). Though families in both cases have limited resources, the diversity in urban areas is much higher due to better availability and hence, children get to eat a variety of food especially seasonal vegetables.

Sources of protein

The selected subjects were basically non-vegetarians, though the frequency of intake of animal food was very low due to economic constraints. Meat and fish were consumed once or twice a week. As presented in Table 2, it was evident that in about 20% of the children's diet, plant food formed the sole source of proteins. Approximately 30% of the children derived 10-20% of protein from animal sources. However about 18-22% of children derived 20-40% and 40-60% of protein from animal food including milk. Since the income of the study population was unstable, the frequency of purchase and consumption of meat products varied and hence the proportion of protein contribution from animal food also varied. On the whole, it can be said that plant sources contribute a larger proportion of proteins even in the diet of non-vegetarians of low socio-economic group as the poor purchasing power limits their intake of animal food.

Energy protein ratio

Energy protein ratio (EPR) indicates whether the diet derives sufficient calories from proteins or whether the diet fulfils the protein requirements if adequate calories are provided. It was found that the EPR of the diets of children of all age groups were above

Table 3. Sources of protein and energy protein ratio (EPR) of diets of children of different age groups

Age group (Age in years)	Mean energy intake(Kcal.)	Mean protein intake (Kcal.)	Protein calories	Calculated EPR	Ideal EPR
4-6	1524	47.3	189	12.4	6.9
7-9	1651	52.0	208	12.6	8.2
10-12	1961	62.2	249	12.7	9.1
13-14	1932	63.7	255	13.2	10.9

the suggested ratio (Table 3) indicating that the children were obtaining the required quantity of protein. However, their energy intake was below the requirements for their age group, as reflected in retarded growth. The EPR value showed a small increase with increasing age indicating slight improvement in protein adequacy in the older children. This could be attributed to consumption of a wider range of food by the children with increasing age or progressive adaptation of the children to the family or adult diet. Similar results have been reported for nutritional surveys undertaken at national levels in India (INP, 1998). The mean protein intake of children between 4-6 and 7-9 years was found to be 136 and 122% of recommendations respectively. Comparatively the energy intake in these groups was only 77 and 79% of the desired intake. A slight reduction in protein intake was observed with increasing age but energy intake was insufficient (INP, 1998).

The average EPR of the diets of children of all age groups is given in Table 3. However, only 22% received adequate calories and protein. More than 34% of them were not receiving adequate amounts of protein or energy. Although almost half of the children (41%) had diets with adequate protein they were insufficient in energy which is not ideal as protein will be utilised for meeting energy needs without supporting growth, the characteristic feature observed in these children. A negligible proportion of children (3%) were receiving diets that were sufficient in calories but

deficient in protein reflecting the poor quality, which again is not growth supportive. In summary, only 22% of the children were consuming diets favourable for growth, being adequate both in protein and energy, whilst the majority of children (65%) were receiving adequate protein only. However, the major sources of their protein were plant food, which are lower in quality than protein from animal sources.

Energy protein adequacy and associated factors

The energy protein adequacy of diets was analysed in relation to various child factors. Approximately 27% of the children had diets that were inadequate in both calories and protein in the 4-6 year group. The rest had adequate protein but insufficient calories (Table 4). None of the children were receiving adequate quantities of both nutrients for this age group. However, the inadequacy level (P^-C^-) was much higher than that reported for a similar age group of rural children of Karnataka state and the average of eight other states (NNMB, 2002).

In the 7-9 year group, the inadequacy of both nutrients was seen in a similar proportion of children; however an improvement in food intake was observed for a small group of 15% (P^+C^+). However, a large group of 60% was observed to be receiving insufficient calories. According to NNMB (2002), a higher proportion of rural children of this age group were receiving sufficient calories and protein.

Table 4. Energy protein adequacy of diets of children in relation to various factors (in %)

Factors	No.	Adequacy pattern				χ^2
		P ⁺ C ⁺ 22%	P ⁻ C ⁻ 34%	P ⁺ C ⁻ 41%	C ⁺ P ⁻ 3%	
Age groups						
4-6 y	15	-	27	73	-	31.127***P = 0.000
7-9 y	102	15	26	59	-	
10-12 y	130	28	38	29	5	
13-14 y	24	17	58	25	-	
Gender						
Male	122	11	30	56	3	17.595***P = 0.001
Female	149	27	37	34	2	
Nutritional grade						
Normal	10	10	50	30	10	12.134 ^{ns} P ≥ 0.05
Grade I	82	25	38	37	0	
Grade II	143	20	38	38	4	
Grade III	36	19	56	25	0	

P⁺ C⁺ : Adequate protein and calories

P⁻ C⁻ : Inadequate protein and calories

P⁺ C⁻ : Adequate protein, inadequate calories

C⁺ P⁻ : Adequate calories, inadequate protein

The proportion of children receiving adequate calories and protein was much higher in the 10-12 year group (28%) in comparison with the 7-9 year group. Children with insufficiency in both protein and calories were also higher in the latter category. In comparison, the percentage of rural children with adequacy in both nutrients was higher and a lesser number of children were found to have insufficient calories and protein (NNMB, 2002). One possible factor for a better adequacy among rural children of similar socio-economic level could be better availability of food in the mainly agricultural rural families. In the 13-14 year group, a higher proportion of children (58%) were not receiving sufficient protein and calories. The adequacy for both was found in a lesser proportion of children (17%) while 25% had adequate protein but insufficient calories.

When the adequacy pattern of the nutrients was viewed in relation to different age groups, children with inadequacy in

both protein and calories increased with age and doubled from the younger to the older age group; while those with sufficient calories but insufficient protein decreased by a third from the younger to the older group. In general, energy and protein inadequacies increased with age. Chi-square analysis revealed the adequacy pattern among various age groups to be extremely significant (P=0.00). Since the study group constituted the growing age group with different growth rates and requirements, age is an important factor in determining the adequacy pattern of both energy and protein.

In relation to gender, this study revealed that inadequacy of calories with sufficient protein was found in a larger proportion of male than female children. Proportion of adequacy of either one or both was found to be significantly better among female children (P=0.001). A better adequacy among females may be indicative of improvement in the position of women,

Table 5. Energy protein adequacy of diets in relation to various maternal factors (in %)

Factors	No.	Adequacy pattern				χ^2
		P ⁺ C ⁺ 22%	P ⁻ C ⁻ 34%	P ⁺ C ⁻ 41%	C ⁺ P ⁻ 3%	
Literacy status						
Level '0'	135	19	36	44	1	7.316 ^{ns} P ≥ 0.05
Level '1'	99	25	30	42	3	
Level '2'	37	8	43	43	6	
Economic status						
Level '1'	103	17	26	56	1	14.893 P < 0.05
Level '2'	157	22	40	35	3	
Level '3'	11	18	46	27	9	
BMI						
Normal	168	22	36	40	2	25.774 ^{***} P ≤ 0.001
CED	43	14	42	44	0	
Overweight	40	18	38	38	6	
Obesity	20	35	40	25	0	

P⁺ C⁺ : Adequate protein and calorie

P⁻ C⁻ : Inadequate protein and calorie

P⁺ C⁻ : Adequate protein, inadequate calorie

C⁺ P⁻ : Adequate calorie, inadequate protein

especially in the socio-economically deprived classes.

In relation to children's nutritional status, it was found that among 'normal' weight children, only a small proportion were receiving adequate quantities of both energy and protein (10%), while 50% did not have enough quantities of both calories and protein. However, the total number of 'normal' weight children was relatively small (n=10). In contrast, a higher proportion of underweight children were receiving adequate quantities of calories and protein. Inadequacy of both calories and protein, and that of calories alone was seen among equal proportions of children in 'mild' and 'moderate' underweight children, while a higher proportion of severe underweight children was placed in the dual inadequacy group. However, no statistical significance was evident indicating that nutritional status is not a factor influencing the adequacy intake of calories and protein, as computed by the method in this study.

The association between some maternal factors with the adequacy pattern of their children's nutrient intake is shown in Table 5. Taking into account maternal literacy, children of mothers in 'level 1' group showed better adequacy of both calories and protein compared to the two other groups. However, application of chi-square showed that maternal literacy level had no significant role in affecting the adequacy pattern of calories and protein. Economic status however was found to show a significant influence on the adequacy pattern of these macro-nutrients. Also, the chi-square analysis revealed the differences in the distribution pattern among the maternal BMI groups to be extremely significant indicating the extent of the influence of maternal nutritional status on the adequacy pattern. The proportion of children with adequacy in both calories and protein was found to be higher by 50% in mothers with normal BMI and 25% among children of 'obese' mothers-compared to that of the 'CED' group.

CONCLUSION

The results of the study showed that the diets of children were inadequate in terms of types of food items, though some improvements with increasing age were observed. The percent adequacies of diets of girls were better than the boys' intake. The intake of green leafy vegetables, milk and sugar was found to be very low, while intake of other vegetables was very good. Only 22% of children consumed diets adequate in protein and energy. However, it should be emphasised that the main sources of their protein were plant sources, which are generally not of the same quality found in animal sources. A majority had protein adequate diets but had insufficient calories indicating that diets were lacking in rich sources of energy as well as protective foods. The energy protein adequacy of diets was significantly associated with age and gender of children and nutritional status of mother. However, these were not influenced by either the literacy or economic level of the families. Thus, intervention efforts should not only aim at improving the socio-economic conditions of slum dwellers in general, but should also address the nutritional needs of mothers and their children.

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