Protein Calorie Intakes and Growth Profiles in Ashram School Students in Nashik District in Maharashtra

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Abstract

Background: Tribal ashram schools provide accommodation, food, and other services from 1st to 12th standards to children from marginalized sections of the society. Nutrition and growth are important aspects of this age group. Objectives: This study aims to estimate average macronutrient intakes in private and public ashram schools and to compare the growth of tribal with urban children and national standards. Methods: This is a cross-sectional cluster-based study in Nashik district of Maharashtra in ashram schools with an urban day school for comparison. The study was conducted from November 2017 to February 2018. The study includes 1510 students in four rural ashram schools and 322 urban school day scholars. Daily food amounts used by the school kitchens were analyzed. Height and weight of students were recorded with standard methods. Excel was used to estimate nutrient intakes and Epi Info for analysis of growth parameters. Results: Protein intakes were 76.5 g/student (2.9–3.1 g/kg body weight), with staples contributing 42%–50% and legumes and pulses contributing 22%–25%. Energy intakes were 2519 kcal/student (100–120 kcal/kg body weight) with oils contributing 13%. Boys ate 1.5–2 times than girls going by average intake of Chapattis. Height and weight of students at entry and exit age, respectively, of 7 and 15 years were significantly lower than urban students, ICMR and IAP standards. However, entry-level stunting had reduced by 15 years by 40%–50% in girls and boys. Conclusions: Macronutrient intakes in the ashram schoolchildren were sufficient, but growth gap persisted till adolescence. Protein quality in private schools needs improvement.

Key words: Ashram school, calories, height, protein, schoolchildren, weight

Introduction

Undernutrition is an important problem for India and Scheduled tribes (ST) suffer most with undernutrition.1,2 India’s multipronged response includes supplementary nutrition to sanitation.3-5 Given the vicious generational cycle of undernutrition, public efforts are rightly focused on antenatal period to 2 years, known as the 1000 days approach. Continued undernutrition in schoolchildren perpetuates stunting, low muscle mass, and micronutrient deficiencies. The STs make nearly one-tenth of Maharashtra’s 11 crore population. Ashram school is a special institution for ST-SC schoolchildren for taking all-round care.6 Thus, ashram schools are expected to ensure sanitation, safe water, nutrition, and health care. The ashram schools effectively bypass the hardships of tribal lives and hence lakhs of ST students are enrolled in the 1576 government and private ashram schools. The government recommends an average protein intake of about 100 g/student, but financial provisions discriminate against private schools.7 Anecdotal reports in press and assembly discussions indicate sporadic malfunction of these services. However, this question of food intake needs periodic exploration of ground realities, but such studies are scant. A study in Delhi’s day schools surprisingly reported much lower protein intakes as compared these recommendations.8 This study aims to estimate macronutrient intakes in ashram schools in Nashik district against existing Government guidelines. Second, this study aims compare growth of tribal with urban children and national standards near school entry and exit age.

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Materials and Methods

Study material and time frame

STs in Maharashtra constitute 9% of the state population spread over 15 districts. The STs in Nashik district are mainly Kokna, Mahadev Koli, Varali, and Thakur making about 30% of ST population in the state. Tribal children live in the ashram schools from 6 to 16 years of age, for about 300 days annually in protected environment as regards nutrition, health care, water safety, sanitation, and without hard physical labor. Every ashram school is almost a small village sitting on 10–15 acres of land. About 8–10 employees manage the kitchen. The Government of Maharashtra supported 1576 institutions with over 4.5 lakh tribal enrolled students in 2016–2017. Some schools have additional higher secondary school, adding another age group up to 17. Quality of food and other services in ashram schools are often raised in media and state assemblies. Parliamentary committee too has raised concerns in its report. The current food guidelines have been given in Maharashtra Government’s GR. In this study, one private and one public school had higher secondary facilities.

The study was undertaken in two government and two grant-in-aid private schools in Nashik district in Maharashtra. The data collection was completed from November 2017 to February 2018.

Sampling and sample size

A two-stage sampling was used to firstly select (a) four out of six tribal blocks and then select and (b) two ashram schools from government and private category, respectively. First, of the six major tribal blocks (Trimbak, Peth, Dindori, Nashik, Kalwan, and Igatpuri) in the district, and four blocks (Dindori, Peth, Igatpuri, and Trimbak) were selected by chit method. Chits bearing school names from four blocks were pooled in two categories – government and private schools. Dindori had ten schools each in government and private category, while Peth had 10 and 4, Igatpuri had 5 and 5, and Trimbak 11 and 13, respectively. Two schools from each category were randomly selected. For comparative anthropometry, an urban school in Nashik was included on feasibility basis.

Proportion of stunting in tribal schoolchildren was used to calculate sample size for a cross-sectional study; using \( p \) (38) for tribal students from an earlier study. The formula, Sample size \( n = \frac{(DEFF \times Np \times (1-p))}{(\Delta^2/Z_{1-\alpha/2}^2 \times (N-1) + p \times (1-p))} \) was used. Allowable error was 5% (33–43), cluster effect and adjustment for absentees were taken as 1.1% and 5%, respectively. Each school was treated as a unit. The estimated sample size was 397 + 5% (say 420) in each Ashram School, hence 1680 for four ashram schools and the urban school.

Inclusion and exclusion criteria

Ashram schools with central kitchen supplies were excluded. The day scholars were omitted for calculation of intakes.

Ethical consent and assent

IEC consent was obtained for the study from the institutional Ethics Committee dated 8.12.17 with Reference number SMBT/IEC/2017/Project −61. The Tribal Development Commissioner and sampled private trust schools gave permission for the study. The schoolteachers were informed a day prior about actual visit date. School names and identities were protected for confidentiality in publications. Assent of students was taken before study in each school at the time of morning prayers explaining that the procedures were nearly similar to routine school health checkups.

Food estimation and anthropometry

Each school was covered for two consecutive days. The total daily food consumption over last 7 days including visit days was estimated from school records. The number of individuals consuming food was adjusted by adding 10% for servants and wastages. To check the veracity of food utilization entries (a) the staples and legumes were weighed on adult weighing scales. These weight records were cross-checked with inventories; (b) cooks and supervisors were asked about quantities of cereals/milletcs and legumes used in morning and evening, apart from items such as oil, poha (rice flakes), vegetables, etc.; (c) flour taken for making dough was also weighed and matched against records; and (d) in schools using volumetric methods such as buckets of flour and pulses. The stated volumes were weighed and checked. Finally, daily food records were photographed and deciphered for data analysis.

Anthropometry was done by male and female researchers for boys and girls separately. Body weight was recorded once with nondigital bathroom scale (Ideal Industries, Pune), with usual school clothes and without footwear or belt. The weighing machine did not show variation once adjusted for plane with spirit-level mobile app. Weighing machine was tested each day against a premeasured weight of sandbag wrapped in plastic. It did not show error of >0.1 kg. The height was taken with a stadiometer (Height 200 cm, No. 26 SM) fixed on wall ensuring head, toes, buttocks, and shoulders touching the wall. To estimate intakes by girls and boys from the pooled data, students age >10 years were asked at the time of anthropometry to about average daily count of Chapatis/Bhakaris eaten. The counts of Chapatis/Bhakaris by recall at the age of 10 and 15 years were analyzed.

Data analysis was done with excel for nutrient estimates. EpiInfo 7.1 (DHIS, CSELS, USA) was used for frequency tables, age estimates, and height and weight comparisons. The weight of boys and girls was pooled for estimating intake of foods per kg of bodyweight. We tested skewness of overall distribution for height and weights, and the coefficient of skewness was −0.1 and 0.62, respectively. Subgroups could be smaller than 30, t-test was applied. Table of Proximate Principles of Common foods from NIN was used to estimate proteins and calories. The comparison of estimated intakes was made with Government directives and RDA (ICMR/NIN). The schools
were given feedback about findings at the end by E-mail and discussion on cellphones.

**Results**

The study included 1510 resident students from four ashram schools and 322 day scholars from urban school. Study population had the following ST composition: 50% Kokna, 27% Varali, 19% Mahadev Koli, 3% Other STs, and 1% students from Thakar community.

Table 1 shows estimates of nutrient intakes in four schools, with protein share of staples, pulses/legumes, and animal proteins. The private schools (W, A) and public schools (T1, T2) have different meal patterns and differential grant-in-aid. All schools provided wheat and rice, but private School A also provides roti (Bhakari) of millet Bajara. Proxy estimates of food intakes showed that the mean count of Chapatis/Bhakaris consumed by 10-year boys (3.32, standard deviation [SD] 1.99) was higher than girls (1.99, SD 1.19, \( P = 0.0001 \)). The difference further widens at 15 years (count for boys was 4.81, SD 2.93 and girls 2.075, SD 1.55, \( P = 0.0001 \)).

Table 2 provides pooled kcal and protein estimates by body weight, sources of proteins in each school, and the difference with the expected Government norm of 100 g protein/student.[7]

The ICMR/NIN recommendations ranged from 1.3 to 1.8 g/kg body weight for ages 7–15 years for both boys and girls.[13] Addition of meat, eggs, and milk in government schools is shown but not included in calculations since addition came after anthropometric assessment.

Table 3 shows mean and SD of height and weight of students in four ashram schools as compared to the urban school at age 7 years (entry level) and 15 years clearly showing that growth of ashram school boys and girls at entry and exit levels were statistically significantly lower than urban students.

The study shows that the proportion of stunting (IAP percentile <3%) for girls declined from 23.43% to 13.7%; also the proportion of stunting (IAP percentile <3%) among boys declined from 28.9% to 13.7%.

Table 4 shows the age-wise mean and SD of height and weight by gender for urban and rural (ashram school) students. It also shows the wide gap denoting urban-rural differences.

**Discussion**

The ashram schools contribute greatly to tribal development and acculturation. The ashram school was mandated by the Central Government since 1991.[14] The traditional tribal diets in these areas are rice and ragi (millet), while ashram school

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Table 1: Daily intakes of dietary proteins and calories in four ashram schools in Nashik district 2017-2018, (1st-10th classes-resident students)*

| Schools                  | Students (add 10%) | Staples cereals and millets | Pulses and legumes | Oil | Potato | Meat/chicken | Eggs (pieces) | Milk (ml) in 2018 | Total daily intake/student |
|--------------------------|--------------------|------------------------------|--------------------|-----|--------|--------------|---------------|------------------|---------------------------|
| Private school W         | 599                | 286.43                       | 49.87              | 19.08 | 11.8   | 0.07         | 0.00          |                  |                           |
| Intake/student           | 0.48               | 0.08                         | 0.03               | 0.03 | 0.01   | 0.00         |               |                  |                           |
| kcal/student             | 1652.65            | 410.23                       | 286.68             | 19.2 | 5.90   | 0.01         | 2375          |                  |                           |
| Proteins/student         | 50.77              | 23.78                        | 0.00               | 0.00 | 1.25   | 0.00         | 76            |                  |                           |
| Private school A¶        | 372                | 204.00                       | 40.00              | 20.30 | 15.7   | 0.00         | 0.00          |                  |                           |
| Intake/student           | 0.55               | 0.11                         | 0.05               | 0.00 | 0.00   | 0.00         |               |                  |                           |
| kcal/student             | 1928.03            | 358.87                       | 491.13             | 41.00 | 0.00   | 0.00         | 2819          |                  |                           |
| Proteins/student         | 58.23              | 22.12                        | 0.00               | 0.1  | 0.00   | 80           |               |                  |                           |
| Government school T1     | 467                | 216.40                       | 55.70              | 15.12 | 13.9   | 466.00       |               |                  |                           |
| Intake/student           | 0.46               | 0.12                         | 0.03               | 0.00 | 0.01   | 1.00         | 250 ml        |                  |                           |
| kcal/student             | 1598.9             | 422.16                       | 291.06             | 28.90 | 5.90   | 60.00        | 167.5         | 2407             |                           |
| Proteins/student         | 40.55              | 25.00                        | 0.00               | 0.00 | 1.25   | 6.00         | 8.00          | 81               |                           |
| Government school T2     | 271                | 132.85                       | 32.87              | 9.60  | 9.4    | 0.00         | 246.00        |                  |                           |
| Intake/student           | 0.49               | 0.12                         | 0.04               | 0.00 | 0.01   | 1.00         | 250 ml        |                  |                           |
| kcal/student             | 1693.2             | 410.30                       | 318.8              | 33.70 | 5.90   | 60.00        | 167.5         | 2522             |                           |
| Proteins/student         | 42.85              | 25.28                        | 0.00               | 0.1  | 1.25   | 6.00         | 8.00          | 83               |                           |
| Total                    | 1710               | 839.68                       | 178.44             | 64.10 | 140.2  | 14.31        | 2.00          |                  |                           |
| All schools**            |                    |                              |                    |      |        |              |               |                  |                           |
| Consumption average (kg) | 0.49               | 0.10                         | 0.04               | 0.1  | 0.01   | 125 ml       |               |                  |                           |
| Kcal                     | 1704.2             | 361.91                       | 337.3              | 104  | 11.75  | 0.08         | 82            | 2519             |                           |
| Proteins                 | 48.34              | 21.65                        | 0.2                | 2.49 | 0.01   | 4            | 75.95         |                  |                           |
| Calories from proteins   | 193.37             | 86.59                        | 0.00               | 0.7  |        |              |               |                  |                           |

*All foods in Kg except milk in ml and eggs in pieces, †The number of individuals consuming food was adjusted by adding 10% for servants and wastages, §Meat and chicken are provided fortnightly, 75 gm twice monthly. Estimates are averaged for daily intakes, ¶Eggs are provided daily in Government schools, an egg per student. || Milk is provided in packs of 250ml since July 2018, ‡This school provides bajara millet in lunch, besides wheat and rice. Others provide wheat and rice, **Figures in parentheses are not included in per student calculation, since they were added after growth measurements were done. These are only included to show changes in Government schools in recent past
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Table 2: Mean age, body weight, and nutrient intakes per student and per kg bodyweight in four ashram schools (girls + boys)

| Schools | Private School W** (standard 1-12th) | Private School A (standard 1-10th) | Government School T1** (standard 1-12th) | Government School T2 (standard 1-10th) |
|---------|-------------------------------------|------------------------------------|----------------------------------------|----------------------------------------|
| Number of girls (n=816) | 275 | 167 | 196 | 178 |
| Number of boys (n=694) | 257 | 172 | 196 | 69 |
| Mean age (SD) | 13.26 (3.91) | 11.59 (3.08) | 13.08 (3.46) | 12.53 (2.88) |
| Mean body weight (SD) | 26.69 (9.29) | 26.09 (9.47) | 26.79 (9.18) | 28.27 (9.05) |
| Energy intake (kcal/Kg) | 100.33 | 120.38 | 101.915 | 101.019 |
| Total kcal (with proteins) | 2678 | 3141 | 2898 | 3012 |
| Protein intake (g/Kg) body weight | 2.9 | 3.1 | 3.0 | 2.9 |
| Proteins from staples (%) | 50.7 (66.9) | 58.2 (72.4) | 40.5 (50.1) | 42.8 (51.3) |
| Proteins from dal/legumes + groundnut (%) | 23.8 (31.4) | 22.1 (38.0) | 25.0 (30.9) | 25.3 (30.3) |
| Animal source proteins (%) | 1.25 (5.3) | 0.00 (00.0) | 15.25 (18.9) | 15.25 (18.3) |
| Total proteins from all sources (%) | 75.8 (100) | 80.4 (100) | 80.8 (100) | 83.4 (100) |
| Shortfall from Government recommended intake (as per annexure 100 g/student), in g | 24.2 | 19.6 | 19.2 | 16.6 |

**These two Schools with additional 11th and 12th standard classes, hence average age is higher

Table 3: Comparison of height and weight of ashram school students at age 7 and 15 years

| Gender (age) | Rural/Urban | Number of students | Mean height (cm) | SD | t-statistics | P | Mean weight (kg) | SD | t-statistics | P |
|--------------|-------------|--------------------|------------------|----|-------------|---|-----------------|----|-------------|---|
| Boys (7 years) | Rural 61 | 110.16 | 4.7349 | 3.8312 | 0.0003 | 16.18 | 1.9558 | 4.7703 | 0.0000 |
| Girls (7 years) | Rural 55 | 109.41 | 4.8407 | 5.4322 | 0.0000 | 15.89 | 2.3908 | 3.2018 | 0.0022 |
| Boys (15 years) | Rural 102 | 153.99 | 8.1892 | 4.1364 | 0.0001 | 38.40 | 7.4079 | 4.4674 | 0.0000 |
| Girls (15 years) | Rural 120 | 147.80 | 5.717 | 3.9662 | 0.0001 | 35.70 | 4.9835 | 5.2065 | 0.0000 |

With urban nontribal schoolchildren. SD: Standard deviation

diets offer wheat and rice as staples. Widespread malnutrition among tribal children is still reported in various studies including the ICDS Monthly Progress Report for August 2018.[2,9,15] The age and body weight statistics in the four schools [Table 2] vary somewhat due to (a) variable enrollment in the first four classes as younger children were shifted to nearby day schools and (b) Presence or absence of higher secondary facilities. The higher number of girls in all standards is reportedly indicative of families shifting boys to other institutes as a better option.

Diets and nutrients

There are scant articles on the estimation of protein-energy intakes of residential schools in India from food records. Among various methods of estimation of nutrient intakes, food records make a robust method, and a 7-day account is usually considered “good standard” for macronutrients.[16] This study of ashram schools offers pooled estimates [Table 1]. The cross verification of food quantities was found to be satisfactory, and all weights stated in the records were found to be closely correct. Second, observation of meals served and inquiry with students independently suggested meals being sufficient. The management knew how many Chapatis, Bhakaris, and rice were required based on student attendance of the day. The new timetable for meals mandated breakfast at 8–9 am, lunch at 12-1 pm, snacks at 2.45 pm, and dinner at 6.30 pm, and this was followed in all four schools.[7] Parents visiting the children also reported that children were eating to satisfaction. However, after 7.30 pm to almost 8 am next day about 12 h elapsed without food. Report of the technical committee for prevention of deaths in ashram schools has the same observation.[17] In two schools, students also carried a chapatti in their pocket after dinner to eat at midnight or early morning.

All ashram schools were following the same rules about food services, but the public schools were getting Rs. 1800/month/student, while the private schools got mere Rs. 900.[7] On inquiry with officers, it was learned that the food bill of government ashram schools is about Rs. 3500/student/month; clearly, about 2–4 times the food grants for private schools.

The food patterns differ in each school based on local habits, choices, management policy, and also the...
Table 4: Height and weight of girls and boys in rural ashram schools and an urban school

| Age (years) | Rural Boys | Urban Boys | Rural Girls | Urban Girls |
|-------------|------------|------------|-------------|-------------|
|             | Height     | Weight     | Height      | Weight      |
|             | Mean SD    | Mean SD    | Mean SD     | Mean SD     |
| 7           | 110.17 4.73| 115.48 6.58| 16.19 1.96  | 18.86 2.54  |
| 8           | 114.51 5.54| 121.97 7.56| 17.38 2.03  | 21.92 3.19  |
| 9           | 118.63 7.20| 126.51 8.37| 19.37 3.42  | 23.56 3.93  |
| 10          | 124.32 4.21| 130.85 5.98| 21.23 2.15  | 27.52 4.16  |
| 11          | 130.55 7.17| 139.83 7.55| 23.36 3.56  | 33.18 9.94  |
| 12          | 133.84 6.21| 144.32 7.10| 25.20 4.41  | 32.22 5.80  |
| 13          | 141.03 9.01| 153.56 7.05| 28.79 5.41  | 40.40 7.92  |
| 14          | 147.62 8.64| 158.36 7.46| 32.63 5.95  | 46.21 9.99  |
| 15          | 154.00 8.19| 165.52 9.32| 38.40 7.41  | 50.35 11.91 |
| 16          | 158.16 7.02| 163.24 5.31| 42.24 5.69  | 54.33 12.19 |

SD: Standard deviation

The optimal proportion of cereals: legumes in diets for correct amino acid balance (correcting lysine deficiency in cereals + methionine deficiency in legumes) is 4:1. This study [Table 2] falls a little short of the recommended ratio at 5:1 (500 g: 100 g), which is also the error in Government guidelines.[19] The sampled schools use local kitchens. A recent study on ashram school diets in Nashik reported that there was no significant improvement in growth outcomes of students with central kitchen over local school kitchens.[9] Local kitchens can innovate and experiment as seen in the food composition [Table 1]. The study underlines that despite various system constraints the protein:energy ratios are well kept in the Indian context of poor intake and lysine deficient diets.[20] Finally, it is worth studying how private schools are able to maintain desired macronutrient intakes on about half the funds accorded to public schools.

Growth gap between ashram school students and urban students

The four tribal schools fall short in mean body weight as seen in Table 2, both at entry (7 years) and exit from school (15 years). The mean height and body weight of these students [Table 4] were well below urban students, the latter being below ICMR-NIN and IAP parameters.[21,22] The entry-level shortfall fits with tribal context, but that they cannot catch up on weight gain.
with urban students, even at exit (15 years), despite adequate protein intake of 3 g/kg body weight, is a cause of concern. IAP charts and tables give percentile levels rather than SD; hence the −3% level of these charts was taken as cutoff for stunting. However, the heartening news from this study is that the stunting levels of boys and girls at 7 years showed 40%–50% by age of 15 years. Although the height gains are less than urban children, the halfway catch up on height is supportive of ashram school life making a positive difference. A study from Nashik on ashram schools also supports decline of stunting in both control and intervention groups.[9] Haddad argues that even if the 1000-day window for intervention in the young child is lost, schools can still help children to catch up with growth after 2 years of age.[21] This study shows the glass is half full on this.

Conclusions

This cross-sectional study of four tribal ashram schools provides pooled estimate of energy (100–120 kcal/kg body weight) and protein consumptions (3 g/kg body weight). This study shows that calorie and protein intakes of ashram schools students are adequate; however, the tribal students are significantly stunted as compared to urban students. The initial stunting levels fell by the age of 15 years. However, they still lag behind urban students. Ashram schools are important to tribal development, providing education, accommodation, food, health education, and care to about across Maharashtra from 6 to 16 or 18 years, and this study of food provisions can give useful clues to growth trajectories. The protein supply at 3 g/kg body weight or 76 g/student is happily in excess of ICMR-NIN norms for plant proteins, yet this falls short of Government guidelines of 100 g/student. Further, it was also seen that girls consumed much less food than boys at both 10 and 15 years. The proteins mostly come from staples (50.1%–72%) and pulses + legumes (30%–38%), while public school students are getting quality protein addition from milk, eggs, and a fortnightly meat dish. The situation is likely to be uniform across the state because of same rules and guidelines covering Government and private ashram schools. However, the irony that private ashram schools get mere 50% of public school grants needs intervention. Finally, good intervention studies are necessary for diet reforms for better growth catchup.

Limitations

This study does not estimate individual food intakes but makes pooled estimates. The sample size for urban school is 322, which is 20% less than the desired sample size of 420, which may somewhat compromise the comparison of growth.

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Conflicts of interest

There are no conflicts of interest.

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