Impact of Nutritious Meals on the Nutritional Status of the Tribal Students: A Comparison between Centralized Kitchens (Annapurna) and Regular Kitchens in Government Tribal Residential Schools from Two Districts of Maharashtra, India

Rajagopal Devara¹, Devika Deshmukh²
¹Principal Secretary, Government of Maharashtra, ²State Consultant for CDN, UNICEF, Mumbai, Maharashtra, India

Abstract

Background: Tackling undernutrition is a global priority. It is the single largest risk factor influencing the burden of disease estimates at the global level. The Annapurna Project was undertaken by Government of Maharashtra to provide nutritious meals to Ashram/residential tribal school students through a centralized kitchen for achieving optimal growth and development and to prevent morbidity. Objectives: The primary objective of our work was to ascertain whether the provision of nutritious meals through centralized kitchens improves the proportion of underweight and stunted children. Methods: We used a cluster trial with parallel intervention and control arms. The allocation ratio was 1:1 for participants in the intervention and control areas. The pilot was undertaken between 2015 and 2017. Tribal dominant Nashik and Palghar districts in Maharashtra were selected by the state government to implement the centralized kitchen plan. Results: At the baseline, the percentage of underweight children in the intervention group was 36.9% and 31.9% in the control groups. The percentage of stunting in the intervention group was 30.0% and 38.2% in the control group. At the endline, 21.9% and 26.3% of the children were underweight. Both groups showed an improvement as compared to the baseline. However, the difference in reduction between the intervention and the control group was insignificant. Similarly, stunting also reduced to 12.9% and 14.6% in the intervention and control groups, respectively. Conclusion: The provision of regular nutritious meals, through centralized and local kitchen in government tribal residential schools of Maharashtra is effective and important in tackling undernutrition in Tribal children.

Key words: Annapurna centralized kitchen, malnutrition, tribal residential school, tribal students

INTRODUCTION

The nutritional status of the population has well-established, profound effects on health throughout the lifecycle and is closely associated with cognitive and social development, particularly in early childhood. Adequate nutrition is especially important in periods of rapid growth and development, i.e., during the first 1000 days of life and adolescence. Poor nutrition during pregnancy, infancy, childhood, and adolescence can result into stunted physical, mental and social development with lifelong consequences. Global evidence suggest that undernutrition continues to affect millions of children. Maternal and child undernutrition, and unstimulating household environments contribute to deficits in children’s development, health and productivity in adulthood. Nearly, half of all deaths in children under-5 are attributable to undernutrition, translating into unnecessary loss of about 3 million young lives globally each year. Additional 165 million children with stunted growth have compromised cognitive development and physical

Address for correspondence: Rajagopal Devara, Government of Maharashtra, Maharashtra, India. E-mail: rgdevara@gmail.com

How to cite this article: Devara R, Deshmukh D. Impact of nutritious meals on the nutritional status of the tribal students: A comparison between centralized kitchens (annapurna) and regular kitchens in government tribal residential schools from two Districts of Maharashtra, India. Indian J Public Health 2017;61:233-8.
Devara and Deshmukh: Impact of centralized kitchen meals on the nutritional status of students in tribal ashram schools

The year 1972–1973. The plan ensured the basic development of rural Maharashtra, Tribal Development Plan was adopted in communities residing in remote and inaccessible areas of the state.

To achieve the socioeconomic empowerment of the Tribal communities by providing primary and upper primary education, thus, the idea of Ashramshala (residential school) was conceptualized. Primary, secondary, and in limited places higher secondary ashram schools are functional in Maharashtra. As per the standard Ashram school code, Ashram schools must have residential facility, provision of nutritious meals, school dress, books, bedding, potable drinking water, toilets, and other education material, which are provided free of cost to the students. The Annapurna Project was undertaken as a pilot project in two districts of Maharashtra state (Nasik and Palghar districts) to provide nutritious meals to Residential Tribal school students for achieving optimal growth and development and to prevent morbidity. The primary objective of this research work was to ascertain whether the provision of nutritious meals through centralized kitchens improves the nutritional status of children in Ashram schools of Maharashtra.

MATERIALS AND METHODS

Study design

We used a cluster trial with parallel intervention and control arms. The allocation ratio was 1:1 for participants in the intervention and control areas.

Study setting

Tribal dominant Nashik and Palghar districts in Maharashtra State were selected by the state government to implement the centralized kitchen plan. We selected these two districts for studying the impact of the intervention.

Study duration

The study was conducted between September 2015 and March 2017. Baseline survey was conducted in Mundhegaon block (Nashik) during September 2015 and in Kambalgaon block (Palghar) during November 2015. The endline was conducted in Mundhegaon and Kambalgaon during March 2017. Thus, the endline was conducted in Mundhegaon after 18 months and in Kambalgaon after 15 months.

Sample size

The sample size for the study was based on the prevalence of malnutrition, which is the primary outcome in the study. This calculation is based on a community-based research on the prevalence of protein-energy malnutrition by Sharma et al. in 2010.12 The proportion anticipated in the treatment group is 20% while in the control group it was 10%. We calculated the sample size using a minimally clinically important difference of 0.5% in the two proportions in the population. We aimed to detect this difference at 80% power and 5% two-sided significance. To allow for clustering, we anticipated the average intraclass correlation coefficient at 0.02 (Killip et al. 2003). With an anticipated drop-out rate of 20%, we required a minimum sample size of 351 individuals in each group at each site.

Totally, 400 students from the Govt. Tribal Ashram schools in the intervention group and 400 students from the Govt Tribal Ashram schools in the control group per each of the two sites.

Statistics on socioeconomic and overall development indicators suggest a large gap between the STs and other social groups. ST children lag behind in school enrolment, attendance, and completion of schooling at primary and secondary levels with literacy levels being 65.7% for Tribal population.11

The nutritional status of adolescent girls aged 15–18 years in Maharashtra showed that total 54.2% girls had body mass index (BMI) <18.5. The proportion of thinness was higher among girls belonging to ST (59.3%) and backward classes (61%).8 The recently released NFHS-4 Data suggests Maharashtra has improved stunting levels, however, wasting has increased.9

ST constitute about 8.2% of the total population of the country. They live in difficult circumstances in hills, forests, and difficult-to-reach geographical areas with limited access to public services.9 According to the Census of India 2011, only 14% of the Tribal population in rural areas have a source of drinking water within their premises and 22.6% households have toilet facility in their households.11 Extreme poverty, cultural habits, lack of formal education, challenges of geographical conditions, and natural disasters are related with poor nutrition and health of Tribal people. Maharashtra has the second largest Tribal population in the country with 9.35% (10.5 million) of the total population. Maharashtra has a credible record of initiating development programs for the STs besides allocating percentage of the State budget for Tribal welfare in proportion to the Tribal population. This plan of allocation of budget is known as the “Maharashtra Model” of tribal sub-plan. It recognizes the need for Tribal welfare within the overall planning strategy with the objective that the welfare scheme reaches out to the last mile recipient from the remotest areas of the state.

Statistics on socioeconomic and overall development indicators suggest a large gap between the STs and other social groups. ST children lag behind in school enrolment, attendance, and completion of schooling at primary and secondary levels with literacy levels being 65.7% for Tribal population.11

To achieve the socioeconomic empowerment of the Tribal communities residing in remote and inaccessible areas of rural Maharashtra, Tribal Development Plan was adopted in the year 1972–1973. The plan ensured the basic development of the Tribal communities by providing primary and upper primary education, thus, the idea of Ashramshala (residential school) was conceptualized. Primary, secondary, and in limited places higher secondary ashram schools are functional in Maharashtra. As per the standard Ashram school code, Ashram schools must have residential facility, provision of nutritious meals, school dress, books, bedding, potable drinking water, toilets, and other education material, which are provided free of cost to the students. The Annapurna Project was undertaken as a pilot project in two districts of Maharashtra state (Nasik and Palghar districts) to provide nutritious meals to Residential Tribal school students for achieving optimal growth and development and to prevent morbidity. The primary objective of this research work was to ascertain whether the provision of nutritious meals through centralized kitchens improves the nutritional status of children in Ashram schools of Maharashtra.

Materials and Methods

Study design

We used a cluster trial with parallel intervention and control arms. The allocation ratio was 1:1 for participants in the intervention and control areas.

Study setting

Tribal dominant Nashik and Palghar districts in Maharashtra State were selected by the state government to implement the centralized kitchen plan. We selected these two districts for studying the impact of the intervention.

Study duration

The study was conducted between September 2015 and March 2017. Baseline survey was conducted in Mundhegaon block (Nashik) during September 2015 and in Kambalgaon block (Palghar) during November 2015. The endline was conducted in Mundhegaon and Kambalgaon during March 2017. Thus, the endline was conducted in Mundhegaon after 18 months and in Kambalgaon after 15 months.

Sample size

The sample size for the study was based on the prevalence of malnutrition, which is the primary outcome in the study. This calculation is based on a community-based research on the prevalence of protein-energy malnutrition by Sharma et al. in 2010.12 The proportion anticipated in the treatment group is 20% while in the control group it was 10%. We calculated the sample size using a minimally clinically important difference of 0.5% in the two proportions in the population. We aimed to detect this difference at 80% power and 5% two-sided significance. To allow for clustering, we anticipated the average intraclass correlation coefficient at 0.02 (Killip et al. 2003). With an anticipated drop-out rate of 20%, we required a minimum sample size of 351 individuals in each group at each site.

Totally, 400 students from the Govt. Tribal Ashram schools in the intervention group and 400 students from the Govt Tribal Ashram schools in the control group per each of the two sites.
Devara and Deshmukh: Impact of centralized kitchen meals on the nutritional status of students in tribal ashram schools

Unit of assignment
Ashram schools.

Unit of analysis
Enrolled residential students within the Ashram schools. Day scholars excluded.

Eligibility criteria (for study settings and study population)
Participating schools: In each district, we identified a block randomly as a study block, i.e., for Nashik district (Mundhegaon, Igatpuri Taluka) and Palghar district (Kambalgaon, Palghar Taluka). In each block, ten schools that were within a radius of 40 kms from the centralized kitchen and receiving the food from the centralized kitchen constituted the intervention schools for that district. Ten schools beyond the 40 km radius that continued to receive the food from local school kitchen were selected to represent the control schools for that district. A total of 40 schools were thus selected for this study representing both districts.

Participants: The study participants included residential students while the day scholars were excluded from the study.

A complete listing of all children in all schools receiving meals from centralized kitchen and local kitchen were obtained. We randomly selected 40 students from each school to represent all ages and both genders. From each class of 1st-9th standard-5 students were selected. We excluded students from 7th class because we anticipated a higher loss to follow-up among these students as they leave schools to join other secondary schools or drop out from formal schools. From each school, a total of 40 students were thus selected (20 boys and 20 girls) to meet the sample requirement of 400 for intervention and 400 for control arms in each block, to achieve a sample size of 800 for intervention and 800 for control arm in the study.

Description of the intervention and control

Intervention
The intervention consisted of the food supplied to the Ashram school students from the “Annapurna” kitchen. Meals provided are unlimited and constitute of breakfast, lunch, snacks, and dinner (timing-7.30–8 am, 12–1 pm, 3–4 pm, 6.30–7.30 pm). The locations of the centralized kitchens in Palghar and Nashik Districts were purposively selected. Schools with good infrastructure and readily available area for installing the kitchens were selected for the pilot. The initial support for setting up the centralized kitchen was made by Tata Trusts. The kitchen operations are managed mainly by trained test driven development (TDD) staff with the support of hired external staff with the recommendations of Tata Trusts. The meal plan is fixed by the nutritionist from Tata Trusts after consulting the students for their preferences and at the same time ensuring varied inclusion of vegetables and pulses in their diet. Quality control of both the kitchen and the supplies was managed by Tata Trusts with the support of senior TDD officials (Project Officers, designated officers-in-charge of the kitchens).

Control
The control group consisted of the students in the schools to whom food was supplied from the local kitchens. There are two Government Resolutions (GR December 2009–2016) passed by the Department which are significant in terms of meal constitution, timing, and purchase. The GR 2009, provided for 3 meals a day skipping snacks, while the GR 2016 included snacks making it four meals a day. Meal plan remains the same and depends on the availability of seasonal vegetables and fruits from local vendors. Detailed guidelines have been issued by the TDD.

Outcomes
Anthropometric measures for the children were measured to observe for changes in nutritional indicators. These outcomes were compared between the intervention and the control groups. We also compared nutritional biochemical parameters that included Hemoglobin levels, Vitamin D and Vitamin B12 among the students. Data for these outcomes were collected twice during the study, at the baseline and the endline for each of the 800 participating students per site.

Ethics clearance
The study was cleared by the Ethics Committee of the Directorate of Medical Education and Research, Government of Maharashtra.

Statistical methods
All variables have been checked for consistency before data analyses. All the analyses have been performed at the level of the individual, as the same subjects have been measured at baseline and endline. BMI for age and Height for age-standardized scores have been derived using the Anthro Plus software (version 1.0.4, Geneva: World Health Organization; 2017). Variables which had a skewed distribution were made symmetric by log transformation. Linear mixed models have been used for assessing differences in means and proportions of the different primary and secondary outcomes in the intervention and control group. The schools are taken to be the clusters in the analysis. The response of the individuals within a school is likely to be correlated with each other and cannot be taken as independent observations. All analyses at endline for the primary and secondary outcomes have been further adjusted for their baseline values. All analyses have been performed in STATA 13. We have presented values mean (standard deviation) (range) for normally distributed data. Values are presented as median (Q1, Q3) (range) for skewed data.

Results
We compared the intervention and the control groups at baseline. The two groups were statistically similar on the primary outcome variable of underweight children. The percentage of underweight children was 36.9% and 31.9% in the intervention and control groups, respectively. The percentage of stunting in the intervention group was 30.0%
and 38.2% in the control group. This difference was also statistically insignificant [Table 1].

At the endline, the intervention and the control groups showed an improvement as compared to the baseline. At endline, 21.9% and 26.3% of the children were underweight in the intervention and control groups, respectively. Both groups showed an improvement as compared to the baseline. However, the difference in the reduction between the groups was statistically insignificant. Similarly, stunting also reduced to 12.9% and 14.6% in the intervention and control groups, respectively [Table 2].

The provision of regular nutritious meals, through centralized and local kitchen in Ashram schools of Maharashtra, is effective in tackling undernutrition in Tribal children.

At the endline, both the intervention and the control groups showed an improvement in underweight children and stunting as compared to the baseline.

**Discussion**

Undernutrition encompasses chronic malnutrition (stunting), acute malnutrition (wasting), and deficiencies of micronutrients. Undernutrition continues to remain the biggest cause of the global burden of disease. Specific programs are therefore designed to provide supplementary food for preschool-aged children and are a strategy towards responding to address this issue.

In its seminal report published in 2006, UNICEF states “Undernutrition is the outcome of insufficient food intake and repeated infectious diseases. It includes being underweight for one’s age, too short for one’s age (stunted), dangerously thin for one’s height (wasted), and deficient in vitamins and minerals (micronutrient malnutrition).” The supplementary feeding strategy attempts to correct this situation by the provision of energy (with nutrients or micronutrients or both) through food (meals/snacks) or beverage to children to ameliorate or prevent undernutrition. As a strategy, supplementary feeding had positive effects on growth in low- and middle-income countries as reported in a Cochrane review. The meta-analysis pooled estimate of the RCTs showed that supplemented children gained an average of 0.12 kg more than controls over 6 months. While this review was

### Table 1: Comparison of intervention and control groups at baseline

<table>
<thead>
<tr>
<th>Variables*</th>
<th>Intervention (n=800)</th>
<th>Control (n=800)</th>
<th>Test statistic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of adolescent girls (+15) having Hb &lt;12</td>
<td>18/28 (64.3)c</td>
<td>35/59 (59.3)</td>
<td>0.19</td>
<td>0.8</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>252 (194.5, 326.5) (85-1297)b</td>
<td>244 (188,332) (86-1256)</td>
<td>0.59</td>
<td>0.5</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>19.4 (6.0) (6.6-43.4)</td>
<td>19.9 (5.0) (6.9-39.6)</td>
<td>−0.58</td>
<td>0.5</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>0.24 (0.08) (0.05-0.65)</td>
<td>0.22 (0.07) (0.02-0.52)</td>
<td>1.56</td>
<td>0.1</td>
</tr>
<tr>
<td>Folic acid</td>
<td>8.1 (3.7) (1.4-24)</td>
<td>8.3 (3.8) (1.7-24)</td>
<td>−0.47</td>
<td>0.6</td>
</tr>
<tr>
<td>Calcium</td>
<td>9.1 (0.4) (7.6-10.3)</td>
<td>9.2 (0.4) (8.1-10.5)</td>
<td>−1.99</td>
<td>0.05</td>
</tr>
<tr>
<td>Protein</td>
<td>7.8 (0.4) (6.5-9.6)</td>
<td>7.7 (0.4) (5.9-9.3)</td>
<td>−0.84</td>
<td>0.4</td>
</tr>
<tr>
<td>TSH</td>
<td>2.1 (1.5,2.8) (0.1-7.3)</td>
<td>2.5 (1.8,3.6) (0.1-22.4)</td>
<td>−2.58</td>
<td>0.01</td>
</tr>
<tr>
<td>STFR</td>
<td>1.9 (1.6,2.2) (0.2-11.5)</td>
<td>1.8 (1.6,2.1) (1-12.2)</td>
<td>1.04</td>
<td>0.2</td>
</tr>
<tr>
<td>Underweight children (%)</td>
<td>286/775 (36.9)d</td>
<td>229/718 (31.9)</td>
<td>0.65</td>
<td>0.5</td>
</tr>
<tr>
<td>Stunting (%)</td>
<td>233/776 (30.0)</td>
<td>263/688 (38.2)</td>
<td>−1.89</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*All comparisons have been adjusted for site; Values are presented as frequency/eligible participants (%), Values are presented as mean (SD) (range), Values are presented as median (Q1, Q3) (range), Values are presented as mean (SD) (range), BMI-for-age Z score could not be calculated for all individuals. SD: Standard deviation, BMI: Body mass index, Hb: Hemoglobin, TSH: Thyroid stimulating hormone, STFR: Soluble transferrin receptor

### Table 2: Comparison of intervention and control groups at endline

<table>
<thead>
<tr>
<th>Variables*</th>
<th>n</th>
<th>Intervention</th>
<th>Control</th>
<th>Test statistic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of adolescent girls (+15) having Hb &lt;12</td>
<td>25/40 (62.5)c</td>
<td>50/78 (64.1)</td>
<td>−0.54</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>690</td>
<td>247 (193,315) (84-761)b</td>
<td>638</td>
<td>246 (194,314) (103-1194)</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>690</td>
<td>16.1 (6.0) (3.4-40)c</td>
<td>638</td>
<td>16.8 (4.8) (5.8-36.1)</td>
<td>−0.34</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>691</td>
<td>0.24 (0.08) (0.07-0.8)</td>
<td>638</td>
<td>0.26 (0.11) (0.06-0.84)</td>
<td>−2.91</td>
</tr>
<tr>
<td>Folic acid</td>
<td>690</td>
<td>9.2 (3.8) (1.5-24)</td>
<td>638</td>
<td>9.2 (3.6) (1.9-24)</td>
<td>0.12</td>
</tr>
<tr>
<td>Calcium</td>
<td>691</td>
<td>9.1 (0.3) (7.2-9.9)</td>
<td>638</td>
<td>9.1 (0.4) (7.7-10.3)</td>
<td>0.24</td>
</tr>
<tr>
<td>Protein</td>
<td>691</td>
<td>7.7 (0.4) (6.6-9.0)</td>
<td>638</td>
<td>7.7 (0.4) (6.4-9.0)</td>
<td>0.33</td>
</tr>
<tr>
<td>TSH</td>
<td>690</td>
<td>1.9 (1.4,2.9) (0.30-10.63)</td>
<td>638</td>
<td>1.8 (1.4,2.7) (0.01-16.22)</td>
<td>2.56</td>
</tr>
<tr>
<td>STFR</td>
<td>690</td>
<td>1.9 (1.6,2.3)</td>
<td>638</td>
<td>1.9 (1.6,2.2)</td>
<td>0.39</td>
</tr>
<tr>
<td>Underweight children (%)</td>
<td>151/690 (21.9)d</td>
<td>167/636 (26.3)</td>
<td>−1.03</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Stunting (%)</td>
<td>89/690 (12.9)</td>
<td>93/637 (14.6)</td>
<td>0.16</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

*All comparisons have been adjusted for site and baseline values; Values are presented as frequency/eligible participants (%), Values are presented as median (Q1, Q3) (range), Values are presented as mean (SD) (range), BMI-for-age Z score could not be calculated for all individuals. SD: Standard deviation, BMI: Body mass index, Hb: Hemoglobin, TSH: Thyroid stimulating hormone, STFR: Soluble transferrin receptor
limited to including children only up to the age of 5 years, it concludes that feeding programs for young children in low- and middle-income countries can work, but good implementation is the key.

The mid-day meal scheme was launched by the Government of India in 1995 with the objective of giving a boost to universalization of primary education by increasing enrolment, attendance and retention and simultaneously improving the nutritional status of students in primary classes.[16] The government of Maharashtra proactively took several steps towards the protection and fulfillment of this right as guaranteed through the Supreme Court judgment. This paper assesses the impact of nutritious meals prepared in centralized kitchens on the health of school students in two Tribal districts of Maharashtra.

As per data from 2015 to 2016, the Govt. of Maharashtra has a large infrastructure to support Tribal students with 1,576 institutions with 4,45,452 Tribal students enrolled in these institutions. Ashram schools, being residential in nature offer a unique opportunity to improve the nutritional status in Tribal communities. By offering wholesome, four meals every day, it can ensure children enter adolescence and adulthood in a healthy State. This requires supply of daily high quality, nutritionally balanced meals for the students. The current Ashram school kitchens are challenged on quality control and hygiene and are dependent on several factors such as timely supply of vegetables by the supplier, the seasonal vegetable availability, quality control by the staff and timely provision of meals. Keeping this in mind, the Centralized Kitchen concept was built on three principles: Ensure nutritious meals consisting of both macro- and micronutrients are made available to students thereby meeting their recommended daily allowance (RDA); Ensure quality, quantity and frequency (timely) of meals and; Ensure hygiene and clean cooking environment.

Our intervention did not find a statistically significant improvement between the intervention and control groups over the intervention period of 18 months at Mundhegaon and 15 months at Kambalgaon. However, both the intervention and the control groups showed an overall improvement in their underweight status and the proportion of stunting in the two groups. Impact of a nongovernment organization (NGO) run mid-day meal (MDM) program on nutrition status and growth of primary school children published in the Indian Journal of Pediatrics[17] found that MDM provided by the NGO has no better impact on growth of the primary school children, however, it reduced prevalence of vitamin deficiency significantly in comparison to the MDM run by Village Panchayats.

The Centralized kitchens provide the advantage of well-regulated, quality meals that are nutritionally wholesome. We believe that our intervention also had provided these advantages to the children in the intervention schools. In comparison, it is recognized that the locally produced meals in schools have the advantage of not incurring any transportation costs as well as a potential of involving parents and civil society in the governance of school meal services. The involvement of parents and civil society has a positive influence that steers service innovation and a shift towards more sustainable practices.[17] This is apparent as the effects of innovation and accountability produced a marked improvement in the two groups of intervention and control at the endline.

The evaluation of the MDM scheme by the Planning Commission published in 2010[18] suggests that the Cooked MDM Program has been successful in addressing classroom hunger and facilitates achieving the objective of social equity. However, the program has also resulted in the diversion of the attention of teachers and students on activities related to the program, rather than towards teaching and learning activities, which results in loss of studies. Additionally, the evaluation also noted the shortage of basic infrastructural facilities and workforce.

Societal welfare would be higher if we choose to implement MDM scheme over income supports and/or food stamps program such as in the United States.[19] Deodhar et al.[19] argue that while the ultimate solution to be achieved by health ministries and departments at various governmental levels is a change in preferences towards better nutrition for children, something urgent still needs to be done in short and the medium run. They propose that the solution lies in providing incentive in such a fashion that households choose to send their children to school and increase children’ food consumption.

Deodhar et al.[19] have identified three critical aspects of the scheme: Managerial, technical, and school logistics issues. While an examination of the managerial issues was beyond the scope of their study, they considered that a centralized production facility would go a long way in addressing technical issues as identified by Deodhar et al., namely, the nutritional and food safety concerns. The presence of a strict quality control can be expected to adhere to the nutritional RDAs for children; and food safety norms in terms of microbial, chemical and physical contamination. In addition, a centralized kitchen would also be expected to overcome logistical issues such as procurement, storage, preparation, and serving and disposal of food at the level of the school.

The kitchens were visited by departmental officials, elected representatives, officials from other States and local villagers.
The department maintained complete transparency in the functioning of these kitchens. Several meetings and discussions were held with the local communities to explain the workings of these centralized kitchens. The centralized kitchens have been appreciated, particularly their hygiene and the food standards by the visitors. Illustratively, “(the centralized kitchen) is a symbol of pride to the tribal development department” was recorded by a senior IAS officer. A team from Andhra Pradesh led by a senior IAS officer observed that “Centralised Kitchen as an institution stands as epitome of dedication of government towards tribal welfare. We are all enthused by the systematic changes …”

We also undertook an analysis of multiple other biochemical parameters in the children. We believe the results of these biochemical tests provide the numbers that can be used as a comparison by other researchers for subsequent analysis in the future.

Our intervention was carried out on a large sample of school children. While we believe that our pilot had the power to detect an overall improvement in the nutritional status of the children, we did not have the power to detect a difference within different age and sex subgroups. Our study also reported dropouts in some children at the endline who had either left the school or were absent at the time of the survey. We conducted the endline survey after a minimum of 15 months had elapsed from the initiation of the intervention. We believe that the time interval was adequate to detect an improvement in the weight of children.

Our work was limited by the unavailability of data on other covariates at the level of the students, their family and the community. We believe that subsequent studies can include these variables at study conception.

CONCLUSION

The provision of regular nutritious meals, through centralized and local kitchen in government tribal residential/Ashram schools of Maharashtra, are effective and important in tackling undernutrition in Tribal children. At the endline, both the intervention and the control groups showed an improvement in underweight children and stunting as compared to the baseline.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

    economic rationale for investing in stunting reduction. Matern Child
    org/topic/nutrition/malnutrition/ [Last accessed on 2017 Apr 28].
3.  Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M,
    et al. Maternal and child undernutrition and overweight in low-income
4.  Fenske N, Burns J, Hothorn T, Rehfues EA. Understanding child
    stunting in India: A comprehensive analysis of socio-economic,
    nutritional and environmental determinants using additive quantile
5.  Improving Child Nutrition: The Achievable Imperative for Global
    Progress. UNICEF. Available from: https://www.unicef.org/
    from: https://tribal.maharashtra.gov.in/1062/Area—Population. [Last
    accessed on 2017 Aug 13].
7.  Tribal People of Maharashtra – Tribes in Maharashtra, Tribals in
    Maharashtra India. Available from: http://www.maharashtra tourism.net/
    tribes.html. [Last accessed on 2017 Aug 13].
    NFHS4/Maharashtra.pdf. [Last accessed on 2017 Aug 13].
    in/Uploads/Resources/Tribal-low-res-for-view.pdf. [Last accessed on
    2017 May 11].
11.  Census of India Website: Office of the Registrar General & Census
    in/. [Last accessed on 2017 May 28].
12.  Sharma AK, Singh S, Meena S, Kannan AT. Impact of NGO run mid
day meal program on nutrition status and growth of primary school children.
13.  Lazzerini M, Rubert L, Pani P. Specially formulated foods for treating
    children with moderate acute malnutrition in low- and middle-income
    countries. Cochrane Database of Systematic Reviews 2013;CD009584.
    DOI: 10.1002/14651858.CD009584.pub2.
14.  Kristjansson E, Francis DK, Liberato S, Benkhalti Jandu M, Welch V,
    Batal M, et al. Food supplementation for improving the physical and
    psychosocial health of socio-economically disadvantaged children aged
    three months to five years. In: Cochrane Database of Systematic
    onlineibrary.wiley.com/doi/10.1002/14651858.CD009924.pub2/
    abstract. [Last accessed on 2017 Apr 27].
15.  UNICEF – Progress for Children – Introduction. Available from:
    https://www.unicef.org/progressforchildren/2006n6/. [Last accessed on
    2017 Apr 27].
16.  International Approaches to School Feeding: Country Experiences from
    Mali, Chile, and India. Available from: http://foodaid.org/wp-content/
    uploads/2014/08/Rachel-Winch-International_Approaches_to_School-
    Feeding.pdf. [Last accessed on 2017 Apr 26].
17.  Galli F, Brunori G, Di Iacovo F, Innocenti S. Co-producing sustainability:
    Involving parents and civil society in the governance of school meal
    services. A case study from Pisa, Italy. Sustainability 2014;6:1643-66.
18.  Performance Evaluation of Cooked Mid Day Meal. Available from:
    http://www.planningcommission.nic.in/reports/peoreport/peoevalu/
    peo_cmdm.pdf. [Last accessed on 2017 Apr 26].
19.  Deodhar S, Mahandiratta S, Ramani, KV, Mavalankar D, Ghosh S,
    Braganza V. Mid Day Meal Scheme: Understanding Critical Issues
    with Reference to Ahmedabad City. Indian Institute of Management
    Ahmedabad, Research and Publication Department, IIMA Working