Case Study

Improving the nutrition quality of the school feeding program (Mid-Day Meal) in India through fortification: a case study

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Micronutrient malnutrition is widely prevalent in school children in India. India's national school feeding program, the Mid-Day Meal (MDM) scheme, is the largest in the world and caters to 120 million children in primary schools. Complementary strategies such as deworming or fortifying meals provided through the MDM scheme could increase the nutritional impact of this program. India's Supreme Court has directed that only hot, cooked meals be provided in MDM, through a decentralised model. However, in urban areas, big centralised kitchens cook and serve a large number of schools, with some kitchens serving up to 150,000 children daily. The objective of this project was to test the operational feasibility of fortifying the school meal in centralised kitchens, as well as the acceptability of fortified meals by recipients. A pilot was conducted in 19 central kitchens run by the Naandi Foundation in four different States. Several food vehicles were used for fortification: wheat flour, soya-dal-analogue and biscuits. More than 750, 000 children were reached with fortified food on all school days for a period of one year. Fortified food was found to be acceptable to all stakeholders. The government is in favour of continuing fortification. The Naandi Foundation has adopted fortification as their norm and continues to fortify all meals provided from their central kitchens. In conclusion: fortification of school meals with micronutrients can be integrated in the normal cooking process and is well accepted by all stakeholders. This pilot could hold lessons for other states in adopting fortification in MDM.

Key Words: school feeding, food fortification, mid-day meal, India

INTRODUCTION

School feeding helps to eliminate hunger for millions of children around the globe and is contributing to their education, nutrition, health and future productivity as adults.[1] School feeding, defined by the World Bank as 'the provision of food to schoolchildren", is universally recognized as one of the key social safety net programs to protect the poor.[2] In addition to reducing hunger, school feeding provides a potential means to increase attendance in schools. It also improves learning and educational achievement,[3] particularly when accompanied by complementary actions such as micronutrient fortification and de-worming.[4]

School enrolment in India continues to be relatively low and the drop-out rate is high, particularly for girl children. According to National Family Health Survey - 3 (NFHS-3) reports only 83% of primary-school age children (6-10 years) attend school, 88% in urban areas and 81% in rural areas. School attendance drops to 75% for children aged 11-14 years and is only 41% for children aged 15-17.[5]

Truly representative data on the nutritional status of Indian children of primary school age (6-11 years) is sparse. The limited data from the National Nutrition Monitoring Bureau (NNMB) survey of 2006 in nine states found that more than half the children studied were undernourished. The survey found the underweight prevalence to be 63% in 6 to 9 year olds, 57% in 10 to 13 year olds and 63% in 14 to 17 year olds. The NNMB data also showed a high prevalence of micronutrient deficiencies in children, especially calcium, iron and vitamin A. In fact, diets of school-age children were more deficient in minerals and vitamins than in energy and protein. More than 70-80% consume less than 50% of the Recommended Daily Allowance (RDA) of vitamin A and iron (Table 1).[6]

Midday meals (MDM) in schools have had a long history in India. In 1925, a midday meal programme was introduced for disadvantaged children in Madras municipal corporation. By the mid-1980s three states- Gujarat, Kerala and Tamil Nadu and the Union Territory of Pondicherry - had universalized a cooked midday meal programme with their own resources for children in primary schools. By 1990-91, the number of states implementing the midday meal programme with their own resources on

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Manuscript received 21 January 2014.
doi: 10.6133/apjcn.2014.23.s1.01

Table 1. Percentage of children consuming less than 50% of the RDA by gender, age and nutrient

Age (in years)	Gender	Protein	Energy	Calcium	Iron	Vitamin A
7-9	All	10.3	26.0	43.8	77.0	88.3
10-12	Boys	18.3	22.3	60.6	81.4	85.3
	Girls	27.5	16.6	65.2	51.9	87.4
13-15	Boys	30.1	20.8	56.9	84.3	85.5
	Girls	28.6	11.1	57.8	68.0	85.8
16-17	Boys	26.4	13.3	49.2	73.6	85.4
	Girls	24.5	12.4	48.0	72.2	85.3

Source: 'Diet and nutritional status of population and prevalence of hypertension among adults in rural areas, National Nutrition Monitoring Bureau report no. 24, National Institute of Nutrition, Indian Council of Medical Research, 2006

a universal or a large scale had increased to twelve states.

With a view to enhancing enrolment, retention and attendance and simultaneously improving nutritional status among children, the National Programme of Nutritional Support to Primary Education (NP-NSPE) was launched as a Centrally Sponsored Scheme on 15th August 1995, initially in 2408 blocks in the country. By the year 1997-98, the NP-NSPE was introduced in all blocks of the country. It was further extended in 2002 to cover not only children in classes I -V of government, government aided and local body schools, but also children studying in Education Guarantee Scheme (EGS) and Alternative Innovative Education (AIE) centres. Central assistance under the scheme consisted of free supply of food grains at 100 g per child per school day, and subsidy for transportation of food grains up to a maximum of 50 rupees (INR) per 100 kg.[7]

In September 2004, the scheme was revised to provide a cooked midday meal with minimum 300 calories and 8-12 g of protein to all children studying in classes I – V in government and government aided schools.

As of 2008-09, the programme has expanded to include children studying in government, local body and government-aided primary and upper primary schools and the EGS/AIE centres, including Madrasa and Maqtabs, across the country.[8]

A decentralized model where food is cooked and served to children from a small kitchen is the predominant model seen in India's rural areas. These small kitchens are run by women's groups from the same community or in schools by specially appointed helpers. In some instances school teachers take turns to cook and serve the children. In certain urban areas, large centralized kitchens have been set up by not-for-profit organizations like Akshyapaatra, ISKCON (International Society for Krishnaa Conscience) and the Naandi Foundation that cater to a cluster of schools.

Micronutrient deficiencies in school age children being widely prevalent, the MDM guidelines, revised in 2006, recommend providing adequate quantities of micronutrients such as iron, folic acid and Vitamin A. Iron, iodine and vitamin A deficiencies have been identified as the most common micronutrient deficiencies in this group.[8] The amount of energy and protein to be provided through the meal were also increased to 450 kcal and 12 gm of proteins. Guidelines also recommend complementary interventions including semi-annual deworming and vitamin A supplementation, weekly iron and folic acid supplementation and use of iodised salt.[7] These complementary strategies fall under the Department of Health and Family Welfare. They have not been sustainable due to high implementation costs, distribution constraints, low coverage and non-compliance with the intake of these supplements.[9,10] Innovative strategies are therefore required to meet micronutrient needs in this group.

The Naandi Foundation, a non-governmental organization (NGO), runs central kitchens in 4 states: 19 central kitchens cater to nearly 760,000 children with hot cooked meals. The size of the kitchens varies; the smallest caters to 5,000 children and the largest to 150,000 children. The meals and menu vary and reflect local dietary patterns and preferences.

- In order to increase the micronutrient content of the meals served in the MDM, the Global Alliance for Improved Nutrition (GAIN) and the Naandi Foundation jointly developed a pilot food fortification project with the following specific objectives: To identify different food vehicles suitable for fortification and in line with local preferences;
- To determine the operational feasibility of fortification of meals in different kitchens, including the acceptability of fortified meals by the recipients and the potential to sustain and scale up fortification.

Approvals for the pilot study were obtained from the state governments in states where this was implemented. Meetings were held with officials in the department of education and panchayati raj, who were in charge of midday meals and were informed about the proposed fortification of meals, why it was needed and the associated costs. All the officials were convinced that the meals currently being served were deficient in vitamins and minerals and were open to explore the option of fortification.

MATERIALS AND METHODS

Identification of fortification vehicles

The Naandi Foundation runs central kitchens in Andhra Pradesh (AP), Rajasthan, Madhya Pradesh (MP) and Orissa, reaching 760,000 children. In AP and Orissa, children receive rice based preparations on all 6 school days of the week. In MP and Rajasthan, children receive Indian bread made of wheat on 3 days and rice based preparations on the remaining 3 days. All meals are served with a spicy lentil preparation and some vegetables prepared as per locally acceptable recipes.

One kitchen in every state was visited to understand the cooking processes and the types of meals served. Commonly consumed foods were evaluated for their potential suitability as vehicles for fortification. The suitability of

vehicles for fortification was determined using the criteria of frequency of inclusion in school meals, quantity consumed per day, ease of fortification and incorporation into routine cooking and the incremental cost.

Proven fortification interventions were to be adopted and hence no efficacy or effectiveness trials were included in this study. The micronutrients in the cooked samples were tested regularly for the quantity retained after cooking.

Iron deficiency being one of the most common deficiencies in India, food vehicles those allowed fortification with iron were prioritized. The RDA as per the Indian Council of Medical Research (ICMR) recommendation (2010) ranges from 16 mg/day (7-9 year olds) to 21 mg/day for boys and 27 mg/day for girls (10-12 year olds).[11]

Operational feasibility

Operational feasibility is a measure of how well the solution meets the system requirements.[12] The operational feasibility for the pilot was determined by assessing the following indicators:

- Acceptability by all stakeholders
- The potential to sustain and scale up fortification beyond the project period

The pilot was implemented for a period of 15 months, which included a 3 month preparatory phase and 12 months during the academic period for fortification of meals and dissemination of results to stakeholders.

RESULTS

Identification of fortification vehicles

In each of the four states (Hyderabad (Andhra Pradesh), Bhopal (Madhya Pradesh), Udaipur (Rajasthan) and Berhampur (Orissa), one kitchen was visited and food vehicles were assessed for suitability for fortification. A typical rice-based meal serves rice with a lentil-based gravy popularly known as 'dal' or 'sambhar'. Wheat-based meals comprise Indian flat bread called 'roti', served with dal and a vegetable preparation. Different options for introducing fortification that were assessed were therefore:

Wheat flour

100 g of wheat per child per day is provided to children by the Government of India. Wheat flour is used on 3 days a week in kitchens of MP and Rajasthan. Wheat flour is milled in-house in all the kitchens where rotis are served. Flour was fortified with iron, zinc and folic acid providing 5.5 mg of iron, 0.22 mg folic acid and 2.2 mg zinc per child per day. Fortified whole wheat flour was used for making roti on the three days when rotis were served. The cost of fortifying wheat flour was less than US$ 0.02 per child per year.

Lentils

Lentils are used in the preparation of sambhar or dal, two common dishes that are used with rice as well as with rotis. This was considered for fortification since it was used across all kitchens. Two different options were tried out for fortifying lentil preparations.

A vitamin and mineral premix containing iron, folic acid and zinc was added at 250 mg per 15 gm of dal at the end of the cooking process and stirred well to mix thoroughly. In Orissa, Madhya Pradesh and Rajasthan, the dal was thick in consistency making it easier to mix and reducing the risk of segregation on standing. However, in Andhra Pradesh, the sambhar tends to be more dilute. On testing the content of iron from different layers of sambhar (the top, middle and bottom) before serving, it was found that the iron content was high in the bottom layer while there were negligible amounts in the top and middle layers. Since this required sustained motivation from teachers to stir sambhar before serving in order to ensure uniform distribution of iron, this method was rejected.

The other option was to improve the nutrient content of soya dal analogue that was being used by the Naandi Foundation. The soya dal analogue is used to enhance the protein quality of food. Soya dal analogue is prepared using 50% wheat flour and 50% de-fatted soya which is then extruded in the shape of commonly used lentils. Soya dal analogue is then mixed with regular dal in a proportion of 1:4. One of the dal analogue manufacturers conducted trials with technical support from GAIN. Ferrous fumarate was selected as the iron compound of choice. Fortification was limited to iron, since there are still concerns regarding stability of vitamins during extrusion, whereas stability of minerals in extruded products has been well documented.[13] Fortification was done at the level of 3 mg of iron per gram of dal analogue. This provided 9 mg of additional iron to each child, as 3 g of dal analogue is mixed with 12 g of natural lentils. The difference between fortified and non-fortified dal analogue was approximately US$ 0.02 per kg which worked out to an incremental cost of US$ 0.01 per child per year at 600 g per child per year. An additional advantage of using dal analogue was that the cost of dal analogue even when fortified was less than the normally used lentils and since this analogue replaced 20% of regular dal, the overall cost of dal preparation was lower when using dal analogue.

Fortified biscuits

Naandi occasionally provides eggs, fruits and snacks as additional foods to the normal meal. A fortified snack was therefore considered as one of the options. However this was only considered as an additional option and not to replace the regular meal. A special iron fortified biscuit with 5 mg iron per biscuit was developed by GAIN and Britannia India Ltd, a leading biscuit manufacturer in the country. Sensory evaluation of this product was carried out by the Institute of Home Economics. The study evaluated the fortified biscuits using various scales through a panel of nutrition experts (n=11) and students of the Institute (n=51). Sixteen categories of biscuits were tested: 4 iron compounds at 4 different concentrations. Biscuits fortified with ferrous fumarate at 5 mg per biscuit scored the same as non-fortified biscuits in terms of crispiness, taste, texture and overall liking. There was also no perceivable after-taste in fortified biscuits. These fortified biscuits were distributed only among children receiving meals from the Hyderabad kitchen covering 150,000 children. Children were given 2 biscuits a day, for 2 days a week, in addition to the meal they were given. This provided children an additional 20 mg of iron per week. Fortified biscuits cost approximately US$ 0.75 per child per

Table 2. Composition of Premix for different food vehicles

Food Vehicle	Premix	
Soya Dal Analogue	Ferrous fumarate at a dose to provide 3 mg of iron per g of soya dal analogue. 3 g of soya dal analogue is mixed with 12 g of natural lentil providing 9 mg of additional iron per child per day through the dal	
Wheat Flour		Per 100 g of wheat flour
	Electrolytic iron	5 mg iron
	NaFeEDTA	0.5 mg
	Folic acid	0.22 mg
	Zinc as zinc oxide	2.2 mg
Biscuit	Ferrous fumarate	5 mg iron per biscuit

Table 3. Fortification vehicles and fortificants

Fortification vehicle	Frequency of use per week	Iron (mg) per day	Iron (mg) per week
Wheat flour	3 days	5	15
Dal analogue	6 days	9	54
Biscuits	2 days	10	20

year (approximately 4.7% of the total cost of meal.)

Fortified wheat flour, fortified soya-dal-analogue and fortified biscuits were thus the vehicles selected for this pilot based on the various trials. Table 2 provides a summary of details of fortificants used in different vehicles. Table 3 provides details of the amounts of iron consumed through fortification.

Implementation and monitoring

The kitchen staffs were trained on fortification procedures through an on-site training and also through regular contacts. Training sessions were held to inform them of the importance of fortification and its potential impact on the nutritional status of children. They were provided information on correct fortification procedures including information on storage and handling of premix, blending to achieve a homogenous mixture and maintenance of records. Standard operating procedures were developed and displayed in all kitchens. A ready-reckoner for calculating the premix requirement was prepared for easy reference. For wheat flour fortification, training of kitchen staff was undertaken initially during installation and subsequently two more trainings were conducted. Staffs were trained in fortification of flour and quality assurance/quality control measures.

During the first 3 months of implementation, Naandi staffs from headquarters conducted regular bi-weekly monitoring visits to kitchens to assess fortification efforts. Subsequent visits occurred once a month. Periodic refresher training on fortification was done. Quality assurance and quality control in the kitchens were carried out using stringent procedures. Food was independently tested by external labs at regular intervals for microbial contamination. Wheat flour fortification was monitored using spot tests for iron at regular intervals of every batch.

As part of the routine monitoring, the Naandi Foundation maintains truck sheets that are sent to schools every day to collect information on the number of meals received, the number consumed, feedback from teachers on any adverse events and the number of meals required for the next day. This system is used as an important monitoring mechanism for quality of meals as well.

RESULTS

As described in the methodology, the operational feasibility was assessed based on: 1) acceptance of the intervention by stakeholders that included the implementing agency, the Naandi Foundation, concerned departments in the government of respective states and students; and 2) the potential for sustained fortification and scale up.

Acceptance by different stakeholders

The Naandi Foundation showed willingness to undertake the pilot to fortify meals served to children, on the condition that no major change was required in their day to day operations. The other requisite was to be compliant with the Supreme Court's order to provide hot cooked meals. There was no special scale developed to measure acceptance. Continued fortification of meals and willingness to advocate for fortification with government authorities were considered indicators of acceptance of the intervention.

Technical and financial support from GAIN served as a catalyst to take forward this mandate by the government and the Naandi Foundation. All relevant departments were consulted from the beginning and were part of the team that designed the pilot project and its implementation.

Acceptance of meals by children: The truck sheets used for routine monitoring were compared to detect any difference in the number of meals consumed before and after fortification. On an average, 490,000 meals were consumed per day across the 4 states (65% of the students enrolled in schools) and this remained constant, also after commencement of fortification. The remaining 35% that did not consume meals is accounted for by the average absenteeism in schools across the 4 states. The absence of any difference in the meal consumption before and after fortification was taken as acceptance of fortified meals by children.

Random checks by officials from Naandi headquarters were also made in schools to check the quality of the meals. In addition, the Naandi staff also interviewed teachers to understand their perception of the quality of meals. On commencement of the fortification, teachers were informed about the process of fortification and its significance. Teachers were requested to monitor consumption of meals once fortification had commenced. Across all kitchens in the State, teachers reported that

there was no change in the number of children who consumed the meals after fortification had started.

In addition to the general observation of meal consumption by teachers and Naandi staff, interviews were done with parents and students. Five schools were visited (2 in Andhra Pradesh, 2 in Madhya Pradesh and 1 in Rajasthan) and 25 parents (18 mothers, 4 fathers and 3 others) were interviewed. The parents of all children had been informed about the fortification and its relevance. All were satisfied with the quality of meals provided and reported that children relished the meals served in schools. Approximately 150 children were interviewed on the taste of meals in group interviews. 95% of the children interviewed liked the food served in schools. They even mentioned that they waited for meals to be served. The remaining 5% (around 8 children) who did not like the food gave reasons such as, "the food was too spicy" or they "did not like school meals in general". Although the number of children interviewed was small and hence difficult to generalize, when combined with observations from the teachers, the numbers of meals consumed and observations from the Naandi staff, the information obtained does suggest that fortified meals were acceptable to children.

Fortified biscuits used in schools in Hyderabad as an 'add-on' were very popular as determined through observations by teachers and Naandi staff and also snacks are generally preferred by children of that age. Students unanimously responded positively to this intervention.

Sustained fortification

Monitoring visits showed that use of fortified soya dal analogue was fully integrated into the cooking process since it was not a new intervention as far as the cooking process was concerned. Fortification of dal was done by the manufacturer and blending of this dal with regular dal was carried out the same way as was done before fortification was done.

Fortification of wheat flour in 4 kitchens had some challenges. Milling in these kitchens happens on 3 days of the week and the flour is used the following day to make rotis. Fortification equipment comprising a hopper for feeding the flour, chemical doser to add premix and a blender were installed as a separate unit, and thus involved carrying the milled flour and feeding it into the hopper. This requires additional manpower, effort and time. However, because of the commitment of the staff, fortification of wheat flour has also continued as per the protocol.

Fortified biscuits were provided as an 'add-on' only in the schools of Hyderabad – two biscuits twice a week. This initiative of providing fortified biscuits has led to introduction of fortified biscuits in the market by many manufacturers.

Potential for scale up

On conclusion of this pilot project, dissemination meetings were held in the 4 states involving concerned departments in the state governments. State governments have the authority to legislate on issues related to education. Fortification of meals can therefore be adopted by states if the government can be convinced. State governments expressed keen interest and willingness to explore the potential of adopting fortification in all school meals in the State. The Government of India and the state government together provide a budget of nearly US$ 16 per child per annum and in addition gives 100 g of rice or wheat per child per day. Using fortified soya dal analogue and fortified wheat flour will only increase the cost by US$ 0.03 per child per annum and this can be absorbed within the available budget. Dal analogue is available in commercial market and in due course fortified dal analogue may be available and will make it easy for MDM programs to access it. To take the benefits of fortification to larger number of children, there is need to pilot fortification of meals prepared in decentralized small kitchens. Use of fortified soya dal analogue and fortified wheat flour offer great promise for this.

DISCUSSION

Food vehicles for fortification

According to the latest Government of India guidelines, the midday meal should provide 450 kcal and 12 g of protein per child and per day and 700 kcal and 18-20 g of protein for children of class VI and above. The guidelines also recommend that the meal should provide adequate quantities of micronutrients, including iron, vitamin A and iodine. There is no specification on the quantity to be provided or the method through which this can be achieved.[8]

A diverse menu of meals served through the central kitchens of Naandi necessitated identifying a vehicle that was consumed in fairly uniform quantities in all states and in a way that would not interfere with the normal cooking process in the kitchens.

Fortified Rice, although in theory a good option, was rejected because of the higher cost associated with this intervention and the operational difficulties associated with mixing of premix with regular rice. Another demonstration pilot using iron fortified rice concluded that rice can be fortified in central operations such as Naandi kitchens, since fortified rice premix was mixed with regular rice during cooking and was constantly stirred. However, the cost per child per year was US$ 0.44.[14] Also, if mixing did not happen properly, there was clumping of fortified rice. Hence, fortified rice was not considered as the vehicle of choice during this pilot. However, further exploration of this intervention is warranted. Fortified wheat flour was used only in 4 kitchens due to resource constraints.

Point of use fortification of lentils was not adopted due to the inability to ensure proper mixing of the lentil preparation before serving which could lead to uneven distribution of fortificants in the dish.

An advantage of any fortification intervention is its ability to be integrated into existing operations at the manufacturer/central processing level with very little need for behaviour modification at the end-user or consumer level. Therefore point of use fortification of a lentil preparation with its need for sustained commitment and motivation during cooking on a daily basis was not selected. Although this was not selected in this pilot, there have been successful demonstrations of incorporating point-of-use fortification in large feeding programs. Effi-

cacy and effectiveness trials of fortification interventions that involve the addition of a micronutrient premix to cooked food just before consumption have produced promising results in preschool and schoolchildren in India and other countries.[15-17]

Dal is the Hindi word for pulses. Dal analogue is a concept product which closely resembles the natural product in physical, nutritional, organoleptic and functional characteristics. Made from equal parts of soybean flour and wheat flour, with a pinch of turmeric, dal analogue looks like natural dal, tastes almost like natural dal, has 30% more protein, cooks faster, and costs 40% less. India has shortage of pulses and the per capita availability has been decreasing. This has resulted in disproportionately higher cost of pulses compared to cereals. Realizing the need and the potential, UNDP supported the National Dairy Development Board in the mid- nineties to manufacture and market soya dal analogue in India. NDDB continues to retail dal analogue through its Safal outlets all over India. Sensing the huge potential, many private players have entered the market and big plans are afoot to provide dal analogue as a stand-alone substitute. Blend of the analogue with natural dal is also available in the market.[18] Fortified dal analogue was used for the first time in MDM in this pilot project. More trials are planned for the future, to determine the stability of vitamins during extrusion and the potential for including them in the dal.

Operational feasibility

The prevalence of micronutrient deficiencies among school age children in India is thought to be very high although there are only a few studies in India and a few from other countries.[19-21] The available budget for school feeding per child per year (approximately US$ 16), may be sufficient to provide meals but does not allow sufficient diversification of the diet to meet micronutrient needs. Supplementation with iron and folic acid exists as a policy but coverage and compliance are low. Hence fortification remains an important approach to enhance the micronutrient quality of the meals. This pilot project was implemented to improve the nutrient quality of meals in a way that would cause minimal or no interference at all with the normal cooking process followed routinely, using proven fortification methods that are known to improve nutritional status when consumed in adequate quantities and result in meals that are acceptable to all stakeholders.

Acceptance of fortified meals was documented through interviews and comparison of the average number of meals consumed before and after fortification. There was no difference in the number of meals consumed indicating acceptance. Acceptance of fortified meals by school children has been documented elsewhere as well, in a cross-sectional randomized controlled study in rural Himalayan villages of India.[22]

Sustainability of this intervention is ensured due to the minimal interference in the normal cooking methods and incremental cost. Use of fortified soya dal analogue was easily integrated into the cooking process since these kitchens were using (unfortified) soya dal analogue already. The only change was thus in fortifying the dal analogue which was done at the manufacturer level. Wheat flour fortification involved additional work and manpower but due to sustained commitment of staff, fortification continues. Fortified biscuits as an add-on was also integrated easily since Naandi already provides eggs, fruits etc. periodically as an add-on. The cost of fortification at US$ 0.03 per annum excluding the cost of fortified biscuits works out to less than 0.2% of the total cost of the meal and could be absorbed by the government to scale up across the country.

Implementation monitoring will be effective since Naandi already has a well- established quality monitoring system. The Governance Knowledge Centre (GKC) under the Department of Administrative Reforms and Public Grievances (DAR&PG) documented the monitoring system in Naandi and reported that Naandi runs a fool-proof operating system that maintains records of meal quantity and quality at each level, feedback about the meals by route coordinators from schools, school records and also random monitoring by state government. Naandi has transparent operations and has opened its kitchen doors to outside institutions for quality checks.[23]

The strength of this study lies in the fact that it demonstrated the ease with which fortification can be incorporated into school meals. However, a drawback of this study is that the centralized nature of cooking in these kitchens (which makes fortification simpler) differs from the cooking done in many MDM, decentralized, kitchens, thus limiting generalisability of this intervention. Since large parts of the country still have school level or community level cooking, the potential for fortification in these settings needs to be further explored.

Introducing fortification is far more challenging in the decentralized model where the implementation is uneven and there are differences in procurement, menu, meal preparation and administration. Because of the diversity of practices in the decentralized model, introducing fortification in these kitchens poses new challenges. Having seen the success of implementation in the central kitchens, the state governments are keen to draw up plans to integrate fortification in the decentralized kitchens too, but this will take more time. The potential for scale-up of these interventions now exists since concerned government departments have been involved in this pilot from the beginning.

In conclusion, fortification of hot cooked meals prepared and served from the centralized kitchens under the MDM scheme is feasible and acceptable to the beneficiary children, teachers and parents. Studies are needed to document the feasibility of this in school or community level kitchens. Sustained advocacy is needed to convince policy makers to adopt fortification as an important strategy to improve the nutritional status of school children.

AUTHOR DISCLOSURES

This manuscript is an original work and has not been submitted for publication elsewhere. Authors declare no conflict of interest.

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Case Study

Improving the nutrition quality of the school feeding program (Mid-Day Meal) in India through fortification: a case study

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經由強化食物改善學校供餐計畫的營養品質(午餐)：個案研究

印度學童存在廣泛的微量營養素營養不良。在印度國家學校供餐計畫中，午餐(MDM)方案供應一億兩千萬的國小學童飲食，為全世界最大。透過午餐方案，除蛔蟲或強化餐點等互補策略，可增加這個計畫對營養的影響。印度的最高法院已指示，MDM 透過非集中的模式，只能提供熱的熟食。然而，在鄉村地區，大型中央廚房烹調並供應大量的學校，有些廚房每日可供應近十五萬名學童餐點。這個研究的目的為測試中央廚房操作強化餐點的可行性，以及接受者對於強化餐點的接受性。由 Naandi 基金會在 4 個省的 19 個中央廚房，進行一個前驅研究。幾種食物載體被用於強化：麵粉、soya-dal-analogue 及餅乾。有超過 75 萬名兒童在一年內的所有上學日，都可食用到已強化食物。強化食物被所有利害關係人所接受，因此，政府傾向繼續實行強化。Naandi 基金會已將食物強化當作他們的規範，並持續強化所有出自他們中央廚房的餐點。總之，學餐強化微量營養素可結合於一般烹調過程，並被所有利害關係人接受。這個前驅研究可提供其他省在 MDM 採用強化政策的參考。

關鍵字：學校供餐、食物強化、午餐、印度