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EVALUATING THE EFFICACY OF CENTRALIZED KITCHENS IN DELIVERING QUALITY SUPPLEMENTARY NUTRITION: A CASE STUDY OF URBAN VADODARA

KEY WORDS: Centralized Kitchen, Mid Day Meal, Sanitation, and Hygiene, Food Handling

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ABSTRACT

School feeding programs such as PM Poshan, formerly known as Mid-Day Meal in India (the largest feeding program in the world), are designed to provide nutritious food to the children and to improve their physical, mental, and psychosocial health. To tackle the issues of space constraints and improve the quality and reach of the program, various innovations have been adopted for its effective delivery. One such innovation in the delivery of MDM is through partnerships with various NGOs, one of them is The Akshaya Patra Foundation (TAPF). The objective of this study was to observe the process evaluation of the MDM programme at TAPF. Observations were conducted once a month at the central kitchen. A total of 23 observations were made at a centralized kitchen to evaluate the storage facility, food handling practices, and sanitation and hygiene practices followed by employees at TAPF. The results of the study revealed that food storage practices were good. TAPF employees strictly followed all basic sanitation and hygiene practices. Good food handling and cooking practices were adopted. The study concluded that Centralized kitchens may be encouraged to enhance and improve the quality of the MDM programme.

INTRODUCTION

Malnutrition represents an invisible impediment in achieving the Sustainable Development Goals (SDGs). Improving nutrition is essential to reduce extreme poverty and is a road map to progress in health, education, and employment. Twelve of the 17 SDGs contain indicators that are highly relevant to nutrition. In 2019, 690 million people worldwide (8.9 per cent of the world's population) were estimated to be undernourished. The number of people affected by severe food insecurity, which is another measure that approximates hunger, has shown a similar upward trend. In 2019, close to 750 million, or nearly one in ten people in the world, were exposed to severe levels of food insecurity. Considering the total number of people affected by moderate or severe food insecurity, an estimated 2 billion people worldwide did not have regular access to safe, nutritious, and sufficient food in 2019 (FAO et al., 2020). India ranks 2nd in child malnutrition, which is an alarming fact as child malnutrition has a long-term negative impact on the country's economic growth (Vaidya et al., 2013). Development activities that target children are tools for eradicating chronic hunger and lifting developing countries out of poverty traps. By investing in the health and nutrition of school-age children, a country can increase the human capital of its younger generations and achieve sustainable economic growth and human development (Molinas & Regnault de la Moth 2010).

Although the World Bank has included school health as one component of its essential public health package for cost-effective health programs, the nutrition and health of school-age children in the developing world have received little attention (Singh et al., 2014). School feeding is a longstanding and popular development assistance program in low- and middle-income countries to improve both the physical and psychosocial health of children (Galloway et al., 2009). There is evidence that school feeding programs increase school attendance, cognition, and educational achievement, particularly when supported by actions such as de-worming and micronutrient fortification or supplementation (Bundy et al., 2009).

different objectives and goals compared to high-income countries. School meal provision in high-income countries is driven by evidence that the foods children consume in schools are very high in fat and lack adequate amounts of essential nutrients. School Feeding Programs in middle- and low-income countries aim to alleviate hunger, act as a social safety net for low-income households, and increase the enrolment of children into schools in the short term. In the longer term, they aim to improve the nutritional status, attendance, cognitive development, and retention of schoolchildren (Aliyar et al., 2015).

India's Supreme Court has ordered that only hot cooked meals should be provided to children studying in government, local body, and government-aided primary and upper primary schools and the EGS/AIE centers, including Madrasas and Maqtabs, across the country. In many countries, it has been challenging to ensure effective mechanisms through which donors and partners can coordinate their inputs and support. Despite this challenge, at the country level, local and international NGOs play a crucial role in implementing and expansion of school feeding. In India, many NGOs work to counter hunger and malnutrition. Public-private partnerships (PPP) have proven instrumental in improving the quality and reach of the programme. There are many facets that the government considers when selecting a nonprofit to partner with. In urban areas where space is a constraint, a centralized kitchen setup is possible for a cluster of schools. Cooking may, wherever appropriate, be undertaken in a centralized kitchen, and hot meals may then be transported under hygienic conditions through a reliable transport system to various schools (National Programme of Nutritional Support to Primary Education [Mid-Day Meal Scheme] GUIDELINES, 2006). One such innovation in the delivery of MDM is through partnerships with various NGOs, one of which is The Akshaya Patra Foundation (TAPF). It is important to evaluate the quality of meals prepared in a centralized kitchen, as the food is served to a large number of children. Thus, the study aimed to assess the routine food safety procedures carried out in a centralized kitchen of urban Vadodara and the hot cooked meals prepared and transported under hygienic conditions through a reliable

School feeding in middle- and low-income countries has very

transport system to various schools.

METHODOLOGY

Study Design: A cross-sectional observational study was conducted to assess food safety practices at TAPF's centralized kitchen.

Setting: The study was conducted at the centralized kitchen facility of TAPF, which prepares large-scale meals for distribution.

Methods: Observations were carried out as the primary data collection method. Direct observations were made on-site to capture real-time practices in the operational environment. Direct observation of meals is often considered the "gold standard" for dietary assessment tools because it is practical and economical. Direct observation is an underused yet valuable method for collecting evaluation information. The key to observation is "seeing" and "listening." Observation provides the opportunity to document activities, behaviour, and physical aspects without having to depend on people's willingness and ability to respond to questions (Powell and Steele, 2003).

In the present study, through a series of structured, non-participatory on-site observations at the over a centralized kitchen facility were conducted once every month. A total of 23 observations were made at a centralized kitchen for evaluating the storage facility, food handling practices, and sanitation and hygiene practices followed by employees at TAPF (Table 1.)

Table 1: Indicators used for kitchen evaluation

Indicators	Aspects
Kitchen	Basic supplies, Machinery, Storage facilities
Sanitation & Hygiene	Cleanliness of the cooking area, cleanliness of food handlers, food handling, and pest control.
Delivery system	The mobile unit, Distribution challenges

Kitchen Infrastructure & Capacity

Observations focused on the adequacy of the physical environment. This included the availability of potable water, basic supplies of food grains, procurement of vegetables, pulses and oil, adequate machinery for cooking, storing, and the segregation of dry versus cold storage to prevent cross-contamination.

Sanitation & Hygiene Protocols

The assessment of sanitation and hygiene was conducted through a systematic evaluation of cleanliness of the cooking and storage area, personnel hygiene maintained by food handlers, and pest management protocols. Area cleanliness was assessed by monitoring the condition of the cooking area. Food handler performance was measured against standardized safety requirements, focusing on the consistent and correct application of Personal Protective Equipment (PPE), including hairnets, masks, and glove-wearing protocols. Finally, the efficacy of pest control was verified by auditing the functional placement of air curtains and electronic fly-trappers at high-risk entry points. This aspect was evaluated using a binary (Yes/No) checklist.

Delivery & Logistic Chain

The observation extended beyond the kitchen to the dispatch bay. We monitored the Mobile Units (delivery vans) for cleanliness and the distribution challenges faced were noted.

RESULTS AND DISCUSSION

A centralized model refers to a system where a few service providers produce and distribute meals to schools in a town/city, with coverage ranging up to over a lakhs of children. A central kitchen is a food processing unit that

improves the productivity of food on a large scale and in less time. In the central kitchen, the efficiency of production due to automation and process integration is important, along with the skills of the employees in handling food (Fujii et al., 2013). The centralized model is lauded for its efficiency because it minimizes labor costs; uses mechanization, reducing human contact with food with lower chances of contamination; requires less space; and provides economies of scale (Shankar & Natasha, 2013).

The Mid-Day Meal Programme has been strengthened by Private and Corporate Partnerships. One such example is the TAPF mid-day meal programme, which is unique in its approach because technology is extensively used to minimize cost, time, and labor and also to deliver the most nutritious and hygienic food. Food is cooked in a centralized kitchen and distributed to schools using custom-built vehicles. The centralized kitchen facilities were designed and built by TAPF management, which reduces human handling and ensures very high standards of hygiene and cleanliness. The systems of mechanized steam-heated cauldrons also expedite the large-scale cooking process. The cooked food was packed into stainless steel containers and loaded into insulated vehicles. Food is transported to schools located within a radius of 50 km the kitchen.

The Akshaya Patra centralized kitchen had adequate infrastructure, comprising a cooking area, storage area, and cleaning and washing area. Storage areas were separate for storing atta vegetables, rice, pulses and spices. Basic supplies, such as running water, drinking water, and good ventilation facilities, were also available and sufficient. A large number of machines are available to facilitate the cooking process, prepare food in bulk, and minimize cooking time. Entry and exit points in the production area were covered with PVC strip curtains.

A similar kitchen, run by the Naandi Foundation, delivers food to nearly 6,000 schools in Rajasthan (Kaushal S, 2009). The foundation has also established a central kitchen in Hyderabad, from which mid-day meals are supplied to 101,394 children in 891 schools in the twin cities of Hyderabad and Secunderabad. Similarly, the centralized kitchen established in Vishakhapatnam city by the same NGO covers 35,734 children in 111 schools (Josephine & Raju 2008).

The Akshay Patra kitchen has a variety of equipment, including rice cookers and cookers for daal and rice, vegetable cutters, high-speed vegetable peelers, vegetable washers, rice cleaning machines (aspirators), masala grinders, dough makers, roti and sukthadi makers, vegetable crates, steam boilers, digital scales, rice silos for storing cleaned rice, and SS-304 insulated serving vessels. SS-304 insulated serving vessels minimizes heat loss, thus keeping food hot for a longer period of time. This special serving vessel ensures the norms of PM Poshan to serve hot cooked meals to school children.

The kitchen was well equipped with a Reverse Osmosis (RO) plant. RO-purified water was used for cooking. Water softeners were also used by the Akshay Patra Foundation to prepare meals in the centralized kitchen. The other important facilities found in The Akshaya Patra Kitchen were boilers generating steam, which not only ensures that the cooking is safe and retains the nutrition of the ingredients used, but also makes the process hygienic. Second, a steam jet sanitizer was used to clean utensils and plastic curtains. These measures help prevent contamination and are crucial from a food safety perspective. The kitchen also had exhaust fans in each room. To store the cooked food, insulated vessels of three different capacities (big, medium, and small) were available, which helped keep the food warm during transportation by sophisticated mobile vans.

Fortified atta was procured from local mills in Ahmedabad,

and rice was provided free of cost to all schools by the Government of India and was kept in a well-labelled room. The bags were kept according to the date of receipt of the food grains in the store. Storage of atta in bulk quantities was done at a raised platform and away from the walls to ensure easy and adequate cleaning and prevent pest contamination. The FIFO ('First in First Out) method for storage was followed, and older food grains were utilized first to ensure that the quality of food grains did not deteriorate. Various materials has been used for food storage. Vegetable crates were used to store the vegetables. Sacs were used to store rice, wheat, and dal and were placed on raised platforms to avoid contamination. The sacs were arranged neatly in bulk. Rice was cleaned with the help of a rice cleaning machine (aspirator) and cleaned rice was stored in a rice silo. Dal was cleaned manually and stored in a dal silo. To prevent adulteration, all the masalas, such as red chilli and turmeric, were ground in grinders and kept in airtight plastic containers. Thus, good storage practices were followed during the study. During none of the visits were insects and pests visible in the storeroom.

The Akshaya Patra employees strictly followed all the basic sanitation and hygiene practices, such as wearing clean clothes, trimming nails, removing footwear, wearing headgear, and washing hands before and after food handling in all 23 spot observation visits (Table 2). Hand-wash basins equipped with liquid detergent were available adjacent to the changing rooms for the staff.

Table 2: Key Observations on the Personal Hygiene of Kitchen Staff

Parameters	% Observation (n=23)
Clean Clothes	100
No illness	100
No jewellery, watch	100
Worn headgear (hairnet) in the cooking area	100

The good food handling practices followed in the Akshaya Patra kitchen were the use of hand gloves and headgears while cooking and cleaning the pulses, removal of footwear in the cooking area, cleaning of grains and pulses manually as well as through machines, soaking of pulses prior cooking, washing of vegetables before cutting, cutting vegetables in medium or big pieces, using clean water for cooking, cooking rice with insufficient water, cooking meals at appropriate temperatures, covering of food after preparation, and maintenance of adequate temperature. There was a separate designated place for washing raw vegetables and for washing utensils and equipment.

CONCLUSION

The NGOs providing MDM are known for their advanced technology, efficient management, and quality workforce as they have to outreach a greater number of children as compared to that of a single kitchen in a school setup. Studies confirm that the Akshaya Patra Foundation, utilizes advanced engineering and enhanced capacity to manage large scale production of food. A study conducted by Singh P and Noor A, 2018 highlighted their use of Mixed Integer Linear Programming (MILP) to design kitchen networks that ensure food is prepared and delivered within a strict four-hour safety window. These centralized kitchens are noted for being "semi-automated," which significantly reduces human contact and enhances both hygiene and production speed (Sharma et al., 2006). On the other hand, the kitchen sheds at the school premises had minimal infrastructure and supplies to meet the basic need for meal preparation (Iyer and Dhaudiyal, 2010).

The observations highlight that TAPF's centralized kitchen demonstrates robust compliance with food safety and hygiene standards. The presence of advanced equipment,

such as rice cleaning machines, steam boilers, and SS-304 insulated vessels, reflects a strong infrastructure designed to support large-scale meal preparation while ensuring nutritional quality and safety aligns with international guidelines emphasizing infrastructure as a critical factor in safe food preparation (FAO and WHO, 2023).

The consistent use of RO-purified water, steam sanitization, and exhaust systems further reinforces the hygienic environment. Key feature is the adherence to FIFO storage practices and in-house grinding of masalas minimizes risks of contamination and adulteration, aligning with recommended food safety protocols (FSSAI 2018).

Sanitation and hygiene which form one of the most important parts of meal preparation were well ensured and the basic norms of food handling were well implemented in the Kitchen. The employees followed a code of personal as well as general hygiene practices during meal preparation. Pest Control Treatment was done daily in association with Pestcone Pest Control Services. It was notable that all twenty-three observations showed that employees were following hygiene standards. The strict enforcement of personal hygiene measures, combined with safe food handling practices, indicates a well-trained workforce committed to maintaining standards.

Management efficiency is often cited as a differentiator for NGOs compared to state-run decentralized models. While the broader MDM sector often faces challenges with "cook-cum-helpers" being underpaid and undervalued (Whittaker, 2024), specialized NGOs are noted for providing orientation training and professionalizing the workforce. Research indicates that when food suppliers receive formal training in hygiene and quality control at recognized institutions, it leads to a measurable improvement in the overall quality of the meals served in urban school systems (Sharma et al., 2006). These findings consistently emphasise the role of infrastructure, systematic storage, and employee training in ensuring food safety in institutional kitchens. The absence of pests and visible contamination across all visits suggests effective preventive measures.

The efficient management of these NGOs directly translates into better educational metrics. Systematic reviews indicate that regular access to high-quality MDM services provided by these organizations improves school enrollment, attendance, and retention rates while fostering cross-class engagement among students (Banerjee, 2019; Raveenthiranathan et al., 2024).

Thus, the centralized kitchen like The Akshaya Patra Foundation is a unique & successful example of a Public-Private Partnership (PPP) and is a new dimension to the MDM Programme in the country. With better kitchen facilities and maintaining sanitation and hygiene, the system can cater to the reach of a large number of children in a limited time and is more efficient and effective in providing hot nutritious MDM to school children. However, we would recommend continuous monitoring and evaluation of the process at regular intervals to maintain the quality of food.

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