Smart School Canteen for Nutrition and Health: Promoting a Balanced Diet Through Diverse Approaches

Company/Organization

TLC registered dietitian team led by Dr. Yang Min, the School of Public Health at Zhejiang University[1]

Author of this report

Xiao Xiangyi, Good Food Fund, Zhejiang University School of Public Affairs

Abstract

A Balanced diet, “Three Reductions (reducing salt, oil and sugar)”, and food waste minimization are key objectives for the nutritional and health-oriented transformation of catering services. To achieve these goals, catering service operators are working with nutritionists and other stakeholders to drive this transformation. Establishing nutrition and health canteens is one of the effective measures to promote the adoption of healthy lifestyles across society. This case study delves into the student dining scenarios, reviewing the actions by TLC registered dietitian team in the process of building smart nutrition and health canteens since 2015 at Zhejiang University and Zhejiang Hangzhou No.11 High School. It summarizes the development path and challenges of smart nutrition and health canteens. The analysis underscores that smart nutrition and health school canteens, characterized by digitalization and informatization, promote healthy dietary patterns among students by employing multiple levers including data, meal planning and education.

Keywords

smart dining, nutrition and health canteen, dietary pattern, nutrition education

---

This report was completed in 2023. The Good Food Fund expresses gratitude to the TLC Registered Dietitian Team from Zhejiang University for contributing to this case analysis report by participating in interviews, providing supporting materials, and conducting reviews.

Case Introduction

Background

As the urban and rural life quality improves, there is a noticeable decline in malnutrition and nutrient deficiency rates among Chinese. Nevertheless, the current dietary pattern in China remains imbalanced, contributing to an upswing in nutrition-related chronic diseases like obesity, overweight, and hypertension. Residents' well-being is thus grappling with the formidable challenge of nutrition disparities. Issues like overweight and obesity loom large, constituting the primary health concerns for students across primary and secondary schools, and tertiary educational institutions.

In response to these challenges, the National Health Commission issued *Guidelines for the Construction of Nutrition and Health Canteens* in 2020. These guidelines aim to steer the catering industry towards heightened awareness of nutrition and health, elevating the nutrition and health service standard. The document emphasizes the imperative to foster balanced dietary habits and cultivate a nutritional and healthy dining environment, particularly in community senior canteens and school cafeterias. In fact, efforts in the realm of school meals and nutrition programs extend beyond meal provision to encompass nutritional education, imparting pertinent knowledge and skills, and instigating the adoption of healthy dietary principles by children and their families in daily life. Furthermore, the Chinese Association for Student Nutrition & Health Promotion, on Chinese Student Nutrition Day in 2021, released the *Nutrition and Health Promotion for Chinese Children and Adolescents Guideline 2021*, advocating for the systematic, scientific, and comprehensive promotion of children's nutrition education.

About the Guidelines for the Construction of Nutrition and Health Canteens

Aligned with the imperatives of the *Healthy China Action (2019-2030)* and the *National Nutrition Program (2017-2030)*, the National Health Commission issued *Guidelines for the Construction of Nutrition and Health Canteens* in 2020, alongside *Guidelines for the Construction of Nutrition and Health Restaurants*. The objective is to guide the catering industry in enhancing its capacity to provide nutritional and health-oriented services, incorporating a multitude of nutritional elements and adhering to scientifically guided dining practices. The Guidelines encourage and steer food service providers toward the achievement of a nutritional and health-oriented transformation and upgrade, with a focus on balanced diets, reduction of sugar, salt and oil, and eradicating food waste.

The guidelines articulate requirements for constructing dining places promoting nutrition and health across six dimensions: basic conditions, organizational management, personnel training and assessment, creation of a nutritional and healthy environment, cooking and meal planning, and meal services. The establishment of nutrition and health canteens enriches the essence of catering while changing the conventional perception of canteens and restaurants as mere dining spaces, and accentuating nutrition's role as a safeguard of public health.

Simultaneously, with the ongoing fusion of emerging technologies—such as cloud computing, big data, the Internet of Things, and artificial intelligence—with traditional industries, campus nutrition and health canteens are infusing digitalization, informatization, and intelligence to propel nutritious and healthy diet initiatives, presenting innovative solutions for nutritional and healthy diets to society.

Case story

Widespread unhealthy dietary habits among students prompt the development of a smart nutrition canteen line by a professional team

In recent years, the majority of students have assessed the appeal of food based on the enjoyment derived from high-calorie, fried, and spicy foods. These unhealthy dietary habits have led to an increasingly serious issue of overweight, obesity and malnutrition among primary, secondary, and tertiary students. Regarding issues such as unbalanced diet patterns and food waste, the Dining Service Center of Logistics Group at Zhejiang University collaborated with the Therapeutic Lifestyle Changes (TLC) registered dietitian team led by Dr. Yang Min from the School of Public Health at Zhejiang University (referred to as the "TLC team" hereafter) in 2015. They successfully developed the first intelligent nutrition dining line in China. The dining line is a fully automated management system that encompasses ingredient management, meal plan, and nutrition analysis. Consumers serve themselves meals from the dining line, while the system analyzes and summarizes the entire process of dining data and information. Additionally, the team standardized aspects such as dish names, prepared dish weights, and nutrition components, establishing a standardized dish database.

Based on this, in 2018, Zhejiang University's Yuquan Campus Second Canteen introduced the second smart nutrition dining line, integrating "facial recognition" and "precision weighing" technologies. The line operates on a self-service dining model, and consumers link their facial payment information with the tray. After consumers choose their meals accordingly, the intelligent devices precisely calculate the cost by gram, and automatically deduct it; consumers can then view their nutrition intake on their mobile phones.

Upgrading campus smart dining iteratively to provide personalized nutritious meal options for students

Starting in 2019, TLC team extended its efforts beyond universities, using the "Smart Nutrition Dining Line" as a platform to launch pilot programs in various institutions, including the Hangzhou Municipal Government Building, Hangzhou No. 11 High School (referred to as "Hang Eleven"), and Zhejiang Uniview Technologies Co., Ltd.. Among them, the smart nutrition canteen at Hang Eleven is the most distinctive.

As early as 2016, Hang Eleven initiated the Smart Canteen project, officially launching it in May 2017. Building on concepts like informationized procurement and intelligent settlement, the school developed four modules — "smart meal selection, intelligent procurement, payment and meal retrieval, and nutrition analysis". These enable the advancement of student meal ordering and intelligent meal retrieval, building the 2.0 version of the smart campus catering system. Every Wednesday, the school releases a menu of five set meals for the following week, each with various nutrition data. Students can use the school's integrated machine or WeChat to select and pay for their meals for the next week. At mealtime, students queue at the corresponding A, B, C, D, or E windows to collect their selected meals. The system will analyze students' daily meals and provides an analysis report, taking into account their favorite meals, order rates, food intake, and nutrition intake. In October 2017, Hang Eleven upgraded its campus smart dining to version 3.0, incorporating face recognition technology into the meal retrieval process. The

school also developed a WeChat ordering program, allowing students to order meals together with their parents.

In May 2018, Hang Eleven released the first Nutrition Big Data for Middle School Students' Canteen Diet in China. The data revealed deficiencies in the supply of grains and tubers, vegetables, eggs, soy products, and nuts in students' diet patterns. Fish and shrimp were supplied infrequently, while the consumption of livestock and poultry meat was excessive, averaging 45.2 kilograms per person per year. Seizing this opportunity, TLC team introduced nutrition meal planning and education concepts to Hang Eleven, collaborating extensively with the school to implement a cooperative model of "school hardware + TLC team + research projects". In 2021, under the guidance of the TLC team, campus smart dining at Hang Eleven underwent further upgrades. The system could customize meal recommendations based on students' dining records, balancing students' nutrition, health and taste preferences. For instance, if students favored fried foods like hamburgers, the system could suggest a vegetarian alternative. They also introduced nutritious meal sets such as "eye care", "high calcium", "iron supplementation", and "low fat", explaining the nutrition and health characteristics of the dishes. Students could then make selections based on their individual needs.

Integrating food education into smart dining to create a health-supportive environment

As early as 2015, the TLC team, with the support of the Logistics Group at Zhejiang University and the School of Public Health, established the first national "Nutrition Hut" on a university campus, providing students and faculty with guidance on diet planning, nutrition and health consultations, weight management, and other public services. In addition to dietary guidance, Nutrition Hut introduced the TLC Weight Management Program to implement dual interventions in participants' diets and exercise. The TLC Weight Management Program established online groups to supervise participants' exercise through check-ins. Participants uploaded daily photos of their meals, which were then analyzed by dietitians, fostering a community atmosphere for weight loss.

Since collaborating with Hang Eleven, the TLC team has actively explored a healthy food environment on campus over the past two to three years. Specific initiatives include 1) Nutrition Advocacy and Education. Nutrition information and educational materials, such as The Chinese Dietary Guidelines, are posted on the canteen walls. Nutrition knowledge cards are placed on tables, and two height-weight scales are provided for students to monitor their weight regularly. The campus is also equipped with a Nutrition Hut, serving as a place for students to receive nutrition and health consultations. The school places great emphasis on classroom education, conducting food education activities with themes of "salt, fat, and sugar" during important periods such as National Nutrition Week, Chinese Student Nutrition Day, and freshman enrollment. 2) Healthy Supermarket. The school supermarket classifies food products according to the Campus Three Highs (high fat, high sugar, high salt) Food Management Standards, using three colors—red, yellow, and green—to indicate the high, medium, and low levels of fat, sugar, and sodium (salt) content in the food. The supermarket establishes three food zones according to the color category, posting corresponding color-coded signs and health slogans in the relevant food areas to guide students in making rational choices for pre-packaged snacks and beverages.

Addressing the Good Food Pledge

Healthy Eating:
Campus smart nutrition and health canteens rely on nutrition data analysis to achieve rational nutrition combinations and optimize dietary structure.

Reduce Waste:
The smart dining line facilitates canteen quantification and procurement, effectively reducing food waste. The goal is to achieve zero inventory of food ingredients by the end of each day, enhancing production efficiency.

Food Education:
Through platforms such as the Nutrition Hut, reinforced by slogans, nutrition consultations, and classroom education, the initiative aims to further promote healthy diets.

Results and Impacts

The campus smart nutrition and health canteens take digitization and informatization as key drivers, promoting balanced meal recipes and healthy, scientific cooking methods while providing nutrition guidance and interventions. This approach gradually transforms traditional catering concepts and consumers' dietary habits. The TLC team has guided the construction of nutrition and health canteens for 17 schools, including Zhejiang University and Hangzhou No. 11 High School. The Nutrition Hut at Zhejiang University serves individuals across the Zijingang campus. With over eight sessions of weight management training camps and more than 20 sessions of micro-habit formation training camps, the program has served over 2,600 participants. TLC has conducted over 30 activities since 2019 with Hangzhou No. 11 High School, providing food education for more than 300 first-year students annually.

Future prospect

Campus smart nutrition and health canteens face a series of challenges in fine-tuning meal preparation directions based on dietary data, optimizing the cost-benefit ratio of hardware and software investments, and enhancing workforce development. Looking ahead, the initiative aims not only to meet individualized dining needs but also to align with the societal and economic benefits. The key challenge for the future is to enhance replicability and extend the experience of campus smart nutrition and health canteens to more public catering facilities, gaining broader influence.

Discussion

Against the backdrop of promoting Healthy China and Digital China, campus smart nutrition and health canteens, leveraging nutrition data, meal planning, and education channels, are driving a transformation students' diet patterns, thereby improving their nutrition and health. It is worth to explore what

mechanisms these channels employ in promoting rational and healthy dietary patterns, what challenges and difficulties they will face during implementation, and how this model can be optimized and extended to more public catering settings in the future. All these will be further discussed in the case analysis.

Case Analysis

How to Leverage Diverse Channels to Build a Campus Smart Nutrition and Health Canteen?

Utilizing nutritional and health data to profile consumer preferences

Both Zhejiang University's smart dining line and Hang Eleven's smart ordering system employ intelligent dining systems. After completing the meal selection, the system transmits consumer dining data to the backend, analyzing consumers' daily and per-meal intake of food and nutrients precisely. Leveraging big data analysis of food choice records, the system effectively provides accurate recommendations for customized nutrition recipes for the next meal and offers rational dining suggestions. This information technology enables the visualization and precision of individual nutritional intake, fostering good dietary habits and self-health management. Additionally, the instant generation, collection, and feedback of information by the smart big data system bring supply and demand closer, enabling canteen managers to better understand students' dining preferences.

Prioritizing nutritious meal planning to implement the "salt-oil-sugar reduction" policy

The nutrition menu for students' daily meals should strive for a harmonious balance in both nutrition composition and energy provision. Only through such meticulous attention can one ensure the equilibrium of nutrition intake for students and promote balanced diets.

The TLC team, enlisted for the guidance of Hang Eleven's meal planning, adheres to the overarching principle of "less salt, oil, and sugar in cooking, emphasizing ingredient selection and pairing." Each recommended meal set for students undergoes meticulous curation by dietitians, thereby ensuring, to a considerable extent, a prevalence of lean protein sources such as fish and poultry over red meat like pork and beef. Vegetable variety is expanded, with a preference for those rich in calcium, potassium, magnesium, and dietary fiber. Staples encompass a diverse array, including whole-grain rice, sweet potatoes, and corn. In the campus "Salt-Oil-Sugar reduction" action during the first semester of 2019, the school canteen utilized 540 kilograms of salt, whereas in the corresponding period of 2020, the salt consumption decreased to 380 kilograms. This means an average reduction of 1.28 grams of salt per person per day for the entire school populace.

Enhancing personal nutrition knowledge through nutritional health education

International experience indicates that strategies such as nutrition education and improving the dining environment are effective in promoting nutrition-related health. Emphasizing nutrition education and guidance for scientific nutrition and healthy diet in cafeterias and canteens. In this case, both the Nutrition Hut at Zhejiang University and Hang Eleven primarily offer services encompassing body composition analysis, nutrition consultation, and dietary guidance. Following the instrumental assessments, a comprehensive health report is generated, delineating key metrics such as basal metabolic rate, body fat percentage, and muscle content. Subsequently, nutritionists adeptly elucidate the technical terminology embedded within the report, offering tailored recommendations in response to the findings.

Challenges Faced by Campus Smart Nutrition and Health Canteens in the Future

On one hand, the challenge confronting the future development of campus smart nutrition and health canteens lies in striking a balance between procurement costs, consumer awareness, and balanced diets. According to dietary data from Hang Eleven, there is a pronounced overconsumption of meat by students, posing a primary concern in the improvement of students' dietary health. Many Chinese school canteens adhere to operational strategies based on meal patterns and cost accounting when designing menus. They initially establish the proportions and pricing of dishes at low, medium, and high price points. Lower-priced dishes typically comprise cost-effective vegetarian options, while higher-priced items are predominantly meat-based. This approach aligns with both cost-effectiveness and caters to the preference for meat consumption, as perceived by parents' conception of nutrition. Therefore, within the constraints of canteen raw material procurement costs and the dietary preferences of the consumer base, the key challenge lies in leveraging the advantages of smart dining systems and big data analysis to precisely adjust the direction of meal preparation.

On the other hand, the establishment of campus smart nutrition and health canteens faces challenges related to the costs and benefits of hardware and software investments. Regarding hardware investments, the construction cost of smart catering systems is relatively high, and given the varying development levels across different regions or schools, it may be difficult to widely afford such systems. Moreover, after the systems are established and put into operation, equal attention must be paid to balancing the operational and maintenance costs with the benefits. In terms of software investments, the creation of smart nutrition and health canteens necessitates a dedicated team of registered dietitians possessing the capability to provide nutritious meal planning and management for diverse populations. However, there is currently a shortage of qualified nutrition guidance professionals in China, which restricts the widespread adoption of this model. Equally crucial are the school's awareness and attitude towards nutrition issues, funding allocations, and institutional frameworks, as they collectively determine the sustainability of the development of smart nutrition and health canteens on campus.

How to Extend this Case to More Public Catering Facilities in the Future?

The experiences derived from this case can be encapsulated in three key points: transforming user meal selection strategies through presenting nutrition data, altering meal provision and culinary techniques via canteen menu adjustments, and guiding consumers towards scientifically informed nutritious diets through personalized dietary advice. To extend the paradigm of smart nutrition and health canteens from campus to public dining establishments catering to more specialized demographics, such as hospitals and elder care facilities, the ongoing refinement of the smart canteen construction can be advanced in several dimensions:

- Establishing a Nutrition and Health Data Platform for Residents. By thoroughly mining nutrition and health data of diets, optimizing the informatization of nutrition and health baseline data, and enhancing current collaboration between schools, research institutions, and nutrition, health databases,

the goal is to enhance residents' food consumption and nutritional structures, stratified by region, demographic groups, and industries. Thoroughly mining the nutrition and health data, undertaking the informatization construction of basic nutrition and health data, enhancing the integration and shared utilization of information on food nutrition and health databases among current schools and research organizations, and improving residents' food consumption and nutrition patterns regionally, demographically, and industrially.

- Accelerating the cultivation of nutritionist talents. Advocating and incentivizing eligible schools, kindergartens, elderly care facilities, and other establishments to equip or hire dietitians, providing professional, nutritious, and health-focused meal planning. Encouraging dietitians to leverage local dietary cultures and structures, and tailoring their services to the unique gastronomic characteristics of the region, would enhance the promotion of nutrition and health among residents.

- Conducting Diverse Public Food Education Initiatives. Leverage engaging formats that resonate with the masses and utilize a more extensive array of promotional tools, to convey scientifically grounded nutrition principles and knowledge and instill healthy dietary behaviors, habits, and lifestyles among residents.

Dimensional analysis: levers of change employed in the case

Food production and supply	Supply and Demand Coordination	Accurately grasp meal planning and cooking requirements. Connect the catering ingredient requirements of school canteens with food production bases to achieve organic unity between production and consumption.
Food environment	Policies and Regulations	Continuously carry out construction of smart nutrition and health canteens guided by relevant policies such as School Food Safety and Nutrition Health Management Regulations and Nutrition and Health Canteen Construction Guideline. Aim to create a demonstration of a smart nutrition and health canteen.
	Accessibility	Adjust meal planning in time by analyzing students' dietary preferences and deficiencies through consumption big data, prompting adjustments in food ingredient procurement. Ensure the canteens use a variety of fresh ingredients, reducing the use of pickled, cured, and animal-fat ingredients.
	Social norms	Publicize balanced diet policies and disseminate knowledge through various means. Disclose the dining characteristics of campus

		students, creating a nutritious and healthy dining environment through peer effects.
Food demand	Information and education	Conduct diverse nutrition and health education activities and establish a “nutrition and health corner” to enhance student awareness, and transform their attitude and values.
	Behavior change	Provide nutrition feedback to individuals or publicly display the nutrition composition of recipes in prominent locations. Use informational interventions to induce changes in individual food selection behavior. Set up red, yellow, and green zones in the school supermarket, using zoning and eye-catching signs to guide purchasing behavior.
	Dining experience	Create a process of food intake, nutrition feedback, and meal recommendations. Use scientific, accurate, and transparent information to allow students to tangible benefits from a healthy diet, enhancing the experience of sustainable and healthy dining.

Addressing the pillars of sustainable development

PEOPLE Nourishing everyone for health and wellbeing	By focusing on student groups and leveraging channels such as nutrition and health data, nutrition meal planning, and nutrition and health education, the case aims to drive a transformation in the dietary patterns of campus students, improving their nutrition and health.
PLANET Producing in harmony with nature	Through digital platforms, precisely quantify food cooking and dietary intake. This aims to reduce the overconsumption of unhealthy foods and food waste, minimizing the impact on the carrying capacity of the natural environment.

Read more

In February 2021, during an independent UNFSS Dialogue convened by the Good Food · China Food Systems Action Hub, representatives from various stakeholders discussed this case. You can review the discussion recap by clicking here (in Chinese).