

Recollection

Nutrition and Health Monitoring and Evaluation of the NIPRCES in China

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Good nutritional status in childhood serves as the foundation for lifelong health. Malnutrition during childhood can not only impede children's growth and development, but also lead to a higher incidence of chronic diseases in adulthood, thereby increasing the socioeconomic burden. In order to improve the nutritional and health status of children living in economically underdeveloped rural areas, the Chinese government implemented the Nutrition Improvement Program for Rural Compulsory Education Students (NIPRCES) in November 2011 (1). The central government provides nutritional meal subsidies to rural compulsory education students in underdeveloped counties. Initially, NIPRCES covered rural area of 699 national pilot counties across 22 provincial-level administrative divisions (PLADs) in the central and western regions of China. By 2021, the program expanded to encompass 727 national pilot counties and 1,010 local pilot counties spanning 28 provinces in the eastern, central, and western regions of China, serving more than 36 million students.

In order to assess the impact of NIPRCES on children's growth, the former Ministry of Health and the Ministry of Education collaborated to issue the *Work Plan for Nutrition and Health Monitoring and Evaluation of NIPRCES (Trial)* in 2012 (2). Following this, China CDC released the *Technical Scheme for Nutrition and Health Monitoring and Evaluation of NIPRCES (Trial)* in 2012 and its revised edition in 2013. Then, *Nutrition and Health Monitoring and Guidance Program for Rural Compulsory Education Students* was released in 2021. With the backing of education departments, the National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention (NINH) partnered with local CDCs (provincial, city, and county levels) to organize monitoring and evaluation plans annually from 2012 to 2017 (3), as well as in 2019 and 2021. Field surveys were conducted each year from September to December between 2012 and 2017, in addition to 2021, and from March to June 2019.

OBJECTIVES

The primary aim of the Nutrition and Health Monitoring and Evaluation was to extensively gather information on various factors, including food supply or intake, children's growth and lifestyle, and associated risk factors from diverse perspectives, such as counties, schools, children, and parents. The research sought to scientifically assess changes in children's nutrition and health status and related factors in order to identify crucial elements of a balanced diet and healthy lifestyle for nutritional intervention. By evaluating the effects of implementing the NIPRCES, the study aimed to provide a robust scientific foundation for the reasonable implementation of NIPRCES in the future.

SAMPLING DESIGN METHOD

A multi-stage stratified random cluster sampling method was employed in this research. Between 2012 and 2019, the monitoring and evaluation plan encompassed rural areas of all national pilot counties, which included approximately 600 routine monitoring counties. Among these, 50 were identified as key monitoring counties. In 2021, the scope of routine monitoring expanded to encompass both urban and rural areas within national and local pilot counties. Subsequently, the number of key monitoring counties increased to 160, comprising 70 national pilot counties, 60 local pilot counties, and 30 non-pilot counties.

In the routine monitoring counties, 10% of rural primary and secondary schools were designated as routine monitoring schools. In the key monitoring counties, four primary and secondary schools were selected from the routine monitoring schools and identified as key monitoring schools, and increasing to 8 rural and urban schools. From 2012 to 2019, approximately 9,000 schools situated in about 600 counties were monitored during each round, which increased to 12,792 schools in 982 counties in 2021 (Figure 1).

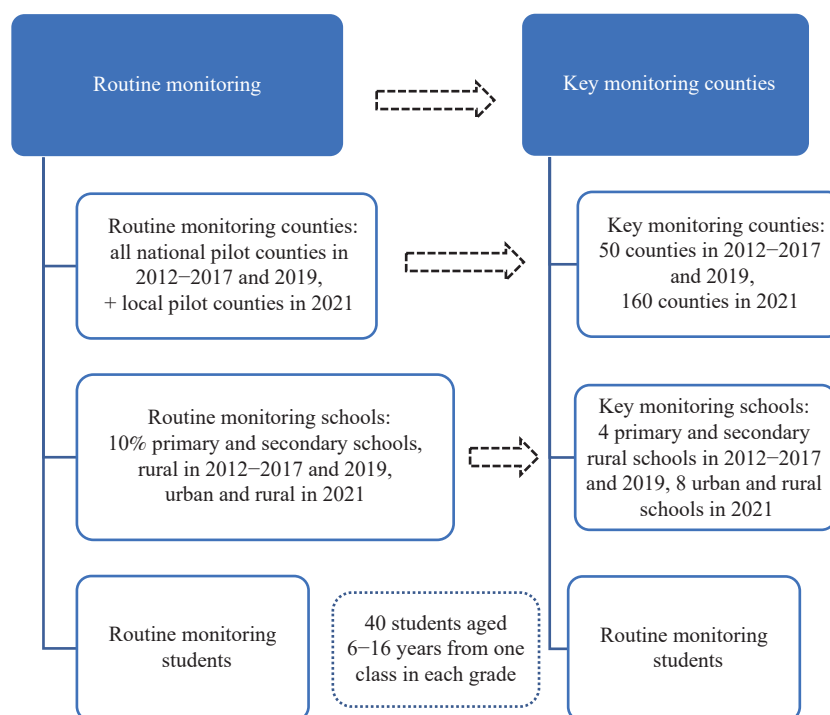


FIGURE 1. The sampling design methodology used between 2012–2017, 2019, and 2021.

In both routine and key monitoring schools, one or two classes were chosen from each grade, with approximately 40 students aged 6–16 years being recruited. Between 2012 and 2019, around one million students were selected per monitoring round, whereas, in 2021, nearly two million students participated. The monitored counties, schools, and students remained relatively consistent, allowing for effective longitudinal tracking throughout the observation period.

DATA COLLECTION

The height and fasting body weight of all students aged 6–16 years were measured using standardized methods and uniform equipment in the morning. Body mass index (BMI) was calculated by dividing weight (kg) by the square of height (m). Stunting or wasting was determined using age-specific and gender-specific height or BMI criteria, as per the Chinese Health Industry Standard for *Screening Malnutrition in School-age Children and Adolescents* (WS/T456-2014) (4). Overweight and obesity were identified based on age-specific and gender-specific BMI criteria, according to the Chinese Health Industry Standard for *Screening Overweight and Obesity in School-Age Children and Adolescents* (WS/T 586-2017) (5). In 2021, additional measurements, such as sitting height, waist circumference, grip strength, and blood pressure, were

obtained from students in key monitoring schools, referred to as key monitoring students.

In this study, whole blood hemoglobin (Hb) levels for the key monitoring students were assessed using the cyanide high iron hemoglobin method, as outlined in the *Method for Anemia Screening* (WS/T 441-2013). Additionally, serum vitamin A and vitamin D concentrations for a subset of these students were determined through liquid chromatography-tandem mass spectrometry (LC-MS), following the guidelines of *Method for Vitamin A Deficiency Screening* (WS/T553-2017) and *Method for Vitamin D Deficiency Screening* (WS/T667-2020). In 2021, blood lipid levels were also analyzed for a subset of the key monitoring students.

In this study, students in primary and secondary schools, who were at least in the third grade (aged 8 years and above), were asked to complete the Student Questionnaire, which gathered data on their food consumption, dietary habits, nutrition knowledge, medical history, physical activity, and lifestyle. Additionally, the Parent Questionnaire was introduced in 2021 to collect information regarding the participating families' socioeconomic status and the primary caregivers' nutritional knowledge and behaviors.

The County Questionnaire and School Questionnaire encompassed all routine monitoring and key monitoring counties and schools. They gathered

information on the implementation of NIPRCES, socioeconomic status, school feeding models, canteen construction, health education, and physical education, among other factors.

The Canteen Food Supply Questionnaire was employed to gather data on the quantities of various food items purchased and consumed, as well as the corresponding number of students and days served for breakfast, lunch, and dinner. This questionnaire was completed by the school canteen or catering center. The Student Absence Questionnaire was utilized to document the daily attendance and absence information for all students. From 2012 to 2019, these two questionnaires encompassed all routine monitoring schools and were restricted to key monitoring schools in 2021.

All data were recorded, uploaded, and provided feedback via a network platform. Data cleaning and analysis were conducted using SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA).

Quality Control

To maintain the quality of monitoring and evaluation, the NINH collaborated with the Ministry of Education to conduct 2–3 annual training courses nationwide for staff members at provincial and selected county-level disease control centers and education departments. Each province organized additional training courses for municipal and county-level staff to enhance their skills in nutrition and health monitoring. Moreover, NINH coordinated on-site investigations and provided guidance through collaboration with local health department experts.

The NINH conducted a comprehensive analysis of monitoring and evaluation data collected in each round, generating thematic reports that were regularly submitted to the Ministry of Health and the Ministry of Education, as well as released to the public as required. Based on these monitoring results, targeted dietary guidance and nutrition education initiatives were implemented in primary and secondary schools across the nation.

In an effort to assist schools in providing balanced diets, the Chinese Health Industry Standard *Nutrition Guidelines for School Meals* (WS/T 554-2017) (6) and the Student Electronic Nutritionist, school meal nutrition analysis system, were published. Numerous educational materials, such as the *Dietary Guidelines for School Age Children* (7), nutrition teaching reference books, posters, leaflets, and videos, were developed and disseminated for use in schools to promote nutritional

education and awareness.

This approach fostered a virtuous cycle of nutrition monitoring and education in underdeveloped rural primary and secondary schools, thereby guiding the implementation of the NIPRCES in a more effective direction. In October 2022, seven ministries, including the Ministry of Education, jointly released the *Implementation Plan for NIPRCES* (8). This plan strengthened management across seven key areas, such as balanced diets, nutrition and health education, and monitoring and evaluation. Its primary aim was to solidify the impact of NIPRCES further, in an ongoing bid to improve both the nutritional status and physical fitness of rural Chinese students.

Conflicts of interest: No conflicts of interest.

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