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Is China's 32 Billion Dollar Program to Fight Rural Undernutrition Working? A Mixed Methods Analysis

Huan Wang, Yaojiang Shi, Wilson Liang, Laura Jonsson, Samuel Kennedy, Gloria Breck, Jane Bai, Qiran Zhao, Matthew Boswell, Scott Rozelle, Alexis Medina

Abstract

As late as 2010, ten million school children in China's poor rural schools were estimated to suffer from micronutrient deficiencies. Fortunately, research conducted in China has shown that well-implemented, school-based nutrition interventions may significantly reduce rates of undernutrition (particularly anemia), and improve educational outcomes. As this link between nutrition and education emerged, the national government acted by initiating a "National Nutrition Improvement Program (*NNIP or, colloquially: The Nutritious Lunch Program*) for rural students in grades 1 to 9" at an annual cost of 32 billion RMB (4.5 billion USD). Within the framework of the NNIP, local education officials in 692 poor counties were directed to provide daily a nutritious in-school meal to over 31.6 million students (Ministry of Education 2012a). Despite the outlay of billions of US dollars per year, no study yet exists that rigorously evaluates the effectiveness of the program. Therefore, the goal of this paper is twofold. First, we seek to evaluate the success of the NNIP. We seek to understand if rates of undernutrition have declined in the period following the launch of the NNIP when compared with the period prior to launch. Second, we will examine in more detail what principal factors appear to affect the NNIP's implementation and ultimately its outcomes.

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I. Introduction

Iron deficiency anemia is the most common nutritional disease worldwide, affecting approximately one-fourth of the world's population, largely in developing countries (Benoist et al. 2008). Iron deficiency anemia reduces the number of red blood cells that carry hemoglobin (Hb), a protein that aids in the transportation of oxygen throughout the human body (Benoist et al. 2008). This shortage restricts the oxygen supply to vital organs such as the heart and brain, potentially leading to loss of blood or even heart failure. Anemia also adversely affects the body's temperature regulation, immune functions, energy, and behavior (Dallman 1986; Benoist et al. 2008). Studies have shown that extreme iron deficiency can lead to cognitive impairment and altered brain functions, as well as negative effects on learning abilities (Scrimshaw 1984; Ramakrishnan and Semba 2008; Yip, Johnson, and Dallman 1984). Indeed, anemia has been linked to poor academic performance, including grades, attendance, and achievement (Li 2009).

In past years, high prevalence of iron deficiency anemia was identified among school children across rural China. As late as 2010, ten million school children in China's poor rural schools were estimated to suffer from micronutrient deficiencies (Luo, Wang, et al. 2011; Luo, Zhang, et al. 2011). These nutritional deficiencies were linked to both poor academic performance (Luo et al. 2012; Sylvia et al. 2013) and higher levels of anxiety (Zhang et al. 2013; Kleiman-Weiner et al. 2013).

Research conducted in China has shown that well-implemented, school-based nutrition interventions may significantly reduce rates of undernutrition (particularly anemia), and improve

educational outcomes. In 2012 researchers demonstrated the effectiveness of nutrition-based interventions in a set of representative schools in Ningxia and Qinghai: within months of receiving nutritional supplement, students achieved measurable gains in school performance (Miller et al. 2012). Similar results emerged from other studies in which treatment students received vitamin supplements for one academic year (Luo et al. 2012). Impact evaluations of the other nutrition-based interventions in Gansu, Ningxia, and Qinghai reported comparable results (Kleiman-Weiner et al. 2013).

As the link between nutrition and education emerged, the national government acted. In October 2011, the State Council announced the “National Nutrition Improvement Program (*NNIP or, colloquially: The Nutritious Lunch Program*) for rural students in grades 1 to 9” (Ministry of Education 2012a) at an annual cost of 32 billion RMB (4.5 billion USD). Within the framework of the NNIP, local education officials in 692 poor counties were directed to provide daily a nutritious in-school meal to over 31.6 million students. The stated objectives of the program were to address the problem of undernourishment and micronutrient deficiencies among school children, supply nutritious food to poor rural students, and to reduce classroom hunger (Ministry of Education 2012a) .

While the NNIP is among China’s most sweeping initiatives to improve the health and nutrition of rural children, it is not clear whether the program has reached its goals. According to our review of the literature, there is no published quantitative or qualitative academic work on this topic. There has only been coverage by the state-sponsored media showing rural families welcoming the NNIP and several small-sample case studies that claim rural students are taller and heavier than in the past (Deng et al. 2017; Ministry of Education 2017). In fact, despite the outlay of billions of US dollars per year, no study yet exists that rigorously evaluates the

effectiveness of the program. In short, after several years of implementation, it is unknown if the NNIP is reducing undernutrition.

The goal of this paper is twofold. First, we seek to evaluate the success of the NNIP. In particular, we seek to understand if rates of undernutrition have declined in the period following the launch of the NNIP when compared with the period prior to launch. Second, we will examine in more detail what principal factors appear to affect the NNIP's implementation and ultimately its outcomes.

To meet the two goals, we employ a mixed-methods analysis that integrates quantitative data and information from qualitative interviews about the NNIP. To evaluate the success of the program in reducing undernutrition in rural schools, we draw on data collected by the authors from the same sample of schools, including the same grade cohorts of students, both before (in 2010-2011) and after (in 2015) the implementation of NNIP. We assess the impact of the program by comparing the levels of anemia among students using an internationally-recognized, in-the-field blood test, as well as other nutritional indicators before and after the implementation of the program. As part of the quantitative analysis, we also seek out what foods the schools are serving as they implement the NNIP and compare these to national benchmarks for recommended daily nutritional intake.

Supplementing the quantitative findings are the results from a series of qualitative interviews undertaken in a subset of the same sample of schools. The interviews sought identify factors that could have driven the quantitative outcomes observed. Using a set of fixed, but open-ended, interview questions, we sought input from key program stakeholders including officials from the county-level bureau of education, principals, teachers, school cafeteria managers, parents, and students.

The rest of the paper is organized as follows. In the next two sections we describe the quantitative data and survey methods and discuss the results of the analysis. In sections 4 and 5, we present the methodology, analytical framework, and results of the qualitative analysis. Most of the findings in section 5 are presented as direct quotations as we seek to understand the key factors related to the program, as voiced by stakeholders. In the final section we summarize the findings and offer recommendations for the future of the program.

II. Quantitative Sampling, Data Collection and Approach

Sampling

Before the NNIP's implementation, we conducted three large-scale nutrition surveys on a random sample of rural schools in Shaanxi, Ningxia, Gansu, and Qinghai provinces.

In choosing our sample observations we followed a uniform selection procedure. First, we obtained a list of all poor counties in each of the study regions. In China, a *poor county* is a designation given by the National Statistics Bureau to identify counties that contain significant concentrations of people that live under the poverty line. There are 592 poor counties in China, making up about one third of the total number of rural counties. About 20 percent of China's population live in these 592 poor counties. In the four study provinces, there are 109 poor counties. From this comprehensive list of poor counties in the four study provinces, we randomly chose 38 counties to be in our study.

Within each sample poor county, the survey team conducted a canvass survey and obtained a list of all *wanxiao* (rural elementary schools with six full grades, grades 1-6) and the number of students enrolled in each. Based on official administrative records, we applied three exclusion criteria to these schools. First, because our interest is in rural schools, we excluded schools that were located in county seats (which primarily enroll urban students). Second,

because China's government is currently consolidating existing rural schools into new centralized schools, we excluded schools with fewer than 150 students to safeguard against excessive attrition. Last, we limited our selection to one school per township.

After applying these exclusion criteria, we randomly selected 100 of 1,730 eligible schools for inclusion in our study. In each school, 50 fourth and fifth grade students were randomly chosen. The location, size, date and other information about the survey are summarized and grouped by province and study year in Table 1.

[Table 1a and Table 1b here]

Data collection

The data for this study were collected both before and after the implementation of the NNIP. We collected pre-program datasets in 2010 and 2011. A follow-up survey in the same schools was implemented in May 2015. During both sets of surveys, we collected information from school administrators, teachers, and cafeteria workers, the parents of students, and students themselves. In both sets of surveys—those that were collected before and after the NNIP—enumerator teams collected data according to the same protocol.

Student Surveys. We interviewed all sampled students at their school, collecting information on student background, health behaviors related to anemia, school activities, and general health. Age was taken from the birth records in each student's matriculation folder. To collect information on school and home feeding practices before and after the NNIP, students were also given standard food frequency questionnaires to record information about food consumption at school and at home over the past week. These variables were based

on the an adapted conceptual model from previous studies (Zhao et al. 2010; Lee et al. 2006), and incorporate measures for the consumption of food items from major food groups, including meat, milk, egg, vegetables, dairy, legumes, nuts, staples, and fruit. Comparing these data, we identify changes in food consumption patterns before and after NNIP in order to monitor potential substitution effects induced through the program. We also compare these data to the nutritional standards mandated by China's national guidelines.

We also measured student blood hemoglobin (Hb) concentration at the time of the student survey. Nurses from the Medical School of Xi'an Jiaotong University accompanied study enumerators, collecting finger-prick blood samples to analyze on-site (at schools) using HemoCue Hb 201+ assessment systems. The nurses also took measurements of each student's height and weight.

Household Surveys. We also collected information on the household characteristics of each student. This information was collected using forms completed by parents, and included information on parent education levels, occupations, and interactions with the school, as well as household location and assets.

School Surveys. Finally, from schools we collected basic information about school enrollment, staffing, facilities, finances, and meal provision, and from teachers about teacher characteristics, their communication with parents, and teaching practices.

We collected our post-program dataset in 2015. In the process of collecting these data, enumerators were recruited the same way as they were in 2010-11. In addition, the survey teams also were trained according to precisely the same survey protocol as they were in the earlier, pre-program period. Post-program survey instruments were identical to those used in the pre-program surveys in order to collect information on the same outcomes as the original study, with

the exception of the post-program survey including one additional block eliciting information on what foods each school prepared as part of the NNIP. We compare these findings with China's national benchmarks for recommended daily nutritional intake. In the post-program survey, we focused on 4th and 5th graders who, according to the program's policy, received NNIP-provided meals for three full years. In other words, the grade four and five respondents in the 2015 were in kindergarten and/or grades one and two at the time of the launch of the NNIP. Worth noting is that we did not follow up with the original students from the pre-program surveys in 2010-11 because they would have been in secondary school or already in the labor force in 2015. Hence, from these two survey efforts (the pre-program and post-program surveys), we have comprehensive data on nutritional status for two cohorts of grade four and five elementary school children who were attending the exact same schools before and after the NNIP.

In accordance with WHO recommendations, the outcomes used to measure undernutrition include anemia status, height for age Z-score (HAZ), and BMI. Hemoglobin concentrations were corrected for altitude as proposed by the WHO. In this analysis (for both the pre-program and post-program data) we use a cutoff of 120g/L to identify children with anemia.

Physical indicators of height and weight were used to construct HAZ scores and body mass index (BMI) using WHO AnthroPlus, a software application of the WHO Reference 2007 for children aged 5–19 years that is used to monitor the growth of school-aged children. We followed internationally recognized cutoffs to calculate the percentage of children whose HAZ and BMI fall below the international mean (WHO, 2006). Individual age was calculated in months as of the date of the examination. Body mass index (BMI) was calculated as body weight divided by height in meters squared.

III. Quantitative Results

Nutrition trends before and after the NNIP

According to our data, the NNIP is not reducing undernutrition among children. When weighting the sample by population, the rate of anemia actually rose from 18.63 percent to 25.32 percent (Figure 1) between pre- and post-program surveys. In Shaanxi and Gansu, the two more populous provinces in the sample areas, anemia rates increased at a statistically significant rate (12.63 percentage points in Shaanxi and 5.25 percentage points in Gansu). In Ningxia, the rate was unchanged statistically. Only in Qinghai, the least populous province did the rate of anemia fall over the course of the study.

[Figure 1 here]

The NNIP also did not improve the anthropometrics of the sample children. Compared with the anthropometrics from students from the pre-program (2010-11) sample, the share of the sample children in the 2015 sample that are *below* average HAZ increased from 72.21 percentage to 82.50 percentage (Figure 1). The proportion of the students that suffered from stunting ($\text{HAZ} \leq -2\text{SD}$) decreased 4.38 percentage points, from 15.97 percentage to 11.59 percentage.

The same general results were found when looking at body mass anthropometrics. Using international body mass index cutoffs for six grades of wasting, the percentage of the students that were below normal weight increased from 19.97 percentage to 23.97 percentage (Figure 1). The share of wasted students in grade one also increased by about 6 percentage points (from

15.83 percentage to 20.07 percentage). The percentages of wasted students in grades two and three were slightly less in the post-program data.

Clearly, as seen from the results of the quantitative date, the NNIP was not working as designed to reduce undernutrition. The rate of micronutrient deficiencies, as measured by the rate of anemia, did not fall after the implementation of the program. The rates of stunting and wasting also did not fall.

Meals before and after the Nutritious Lunch Program

In trying to identify the (at least proximate) reason for the deteriorating nutritional outcomes in rural China after the implementation of the NNIP, our survey data (both pre- and post-program) can be used to track the foods that children ate. One important concern in school feeding studies is that there might be substitution, i.e. when households reduce the consumption of food in the home because children are fed in school (Galloway et al. 2009). In the case of the pre-program data in 2010-2011, we examine what children were eating at home (given that few schools provided meals and almost all children went back home to eat lunch). In the post program survey, we focus primarily on what children were eating at school since most of their noon-time meals were provided by the NNIP at school.

Unfortunately, between the pre-and post- program surveys the diets of children in the study areas had not appreciably improved—either in the home or at school. When examining in-home reported consumption patterns, we can see that they remained almost unchanged from the pre-program time periods. Students consumed meat, milk, and eggs slightly more times per week after the program when compared to before, but consumed vegetables, legumes, and fruits fewer times (Figure 2). Meat consumption rose from 2.63 to 3.74 times per week; milk 1.12 to 2.09 times per week, and eggs 0.98 to 2.81 times per week. Vegetables consumption declined from

3.7 to 2.72 times per week, legumes/nuts from 3.61 to 3.17 times per week, and fruits 2.9 to 1.59 times per week. Consumption of staples such as rice or noodles also declined slightly from 3.61 times per week to 3.17 times per week.

[Figure 2 here]

Meals provided by the National Nutrition Improvement Program

In addition to evaluating nutritional outcomes, we also tried to better understand what foods were being included in school meals following implementation of the program. Here we find a possible factor that may be contributing to the failure of the program to address undernutrition. According to the results of our surveys, however, the nutritional content of the foods provided at school do not approach even closely international or national standards (Figure 3). According to guidelines set forth by China's government, school lunch should account for 40 percent of a child's daily nutritional intake (Ministry of Health, 1998). Unfortunately, the data compiled from our surveys show that the lunches provided by the NNIP fell well short of this benchmark standing at less than 20 percent of a student's daily nutritional needs. Specifically, across all of the schools in our sample, the NNIP provided only 38 percent of the government's recommended daily allowance for meat, and half of the allowance for vegetables. These food groups are both vital sources of iron, the micronutrient needed to alleviate anemia (Iron Disorders Institute 2017). Similarly, program meals fall short in milk, egg, and legume/nut content, serving less than half of the recommended quantity for lunch. Only starches are shown to have been provided in sufficient quantity to meet national lunch standards. According to this data, NNIP meals are far less nutritious than they are supposed to be.

[Figure 3 here]

IV. Qualitative Methods

Our quantitative data paint a disappointing picture. Across all three of our key quantitative metrics—anemia status, HAZ, and BMI—there was no significant improvement in the three years following the implementation of the NNIP (2012-2015). In addition, we also found that the nutritional content of the diets were still far under the national school lunch guidelines. In other words, children—both before and after the NNIP—were not being fed nutritious diets.

The objective of our qualitative analysis is to better understand what factors can account for the NNIP’s failure to alleviate student undernutrition in rural China. To do so, we first draw upon the quantitative findings to develop four hypotheses that may explain the failure of the program. We then organize our qualitative interview data and observations according to how they either support or contradict each of our four hypotheses. In this way we gauge which hypotheses are plausible in explaining the failure of the program. The remainder of the qualitative portion of the paper will cover these steps one at a time.

The hypotheses are based on both the quantitative results and the responses to a freeform question in the post-program survey that prompted school administrators to name the primary challenge in implementing the NNIP. Responses were written in long hand directly onto the survey form. We then tallied the responses and categorized them by theme. Seventy-two percent (167/232) of responses made clear that there were not enough resources to carry out the program, citing shortfalls in the subsidy amount, staffing, or facilities and hardware. Twenty-three percent

(53/232) stated that the biggest challenge was providing a consistently healthful and appetizing menu. No other challenge was cited ten or more times.

Given these results, we proposed four hypotheses for the failure of the program to improve nutrition in rural schools. Because nearly three out of every four administrators cited insufficient resources, we first hypothesize that funds allocated for the program may have never reached the students at all, on account of corruption, systemic fraud, or other supply-side misconduct. Secondly we propose that even if funds were to reach the students, given the large number of undernourished children in rural China, the funds were simply insufficient to purchase nutritious foods in the required quantity. Thirdly, because principals often complained that indirect, non-monetary costs were too high to implement the program effectively, particularly as they relate to staff time and administrative bandwidth, we hypothesize that a shortfall in capacity may also have limited the effectiveness of the program. Finally, because nearly one quarter of administrators cited the difficulty of preparing a healthful menu, we also hypothesize that a lack of nutritional expertise on the part of program implementers may have contributed to the program's failure. As the quantitative analysis ruled out any systematic changes to the student population before and after the program implementation, we did not consider demographic selection to be a viable hypothesis for non-improvement in student nutrition. Similarly, because the quantitative results show no change in nutritional intake at home before and after the program, we also rule out the possibility that parents may be feeding children less in response to the program, thus substituting out program gains.

To test these four hypotheses, we went to the field to collect qualitative interview data. Our sample is comprised of a series of interviews with stakeholders conducted in July 2016. To choose our sample interviewees, we first randomly selected three counties from the pre- and post

program sample in Shaanxi province. Then, we randomly selected four schools from these counties. At each school we interviewed administrators, teachers, students, kitchen staff, and local parents, making them part of our qualitative sample.

In addition to these interviews, we also visited the education bureau in two sample counties to interview the officials in charge of administrating the NNIP in that county. In Table 1b we present a breakdown of the types of stakeholder interviewed. As our sample was drawn from areas known to have high rates of child anemia, randomly selecting our sample from within these areas allowed us to examine the extent to which opinions and beliefs pervasive at the community level affect the implementation of NNIP and the outcomes identified in the quantitative analysis.

The qualitative interviews were conducted by fieldworkers associated with the Center for Experimental Economics of Education (CEEE) in Shaanxi Normal University. The center has ample experience conducting qualitative fieldwork (e.g. Shi et al. 2015; Yue et al. 2016; Xue, Shi, and Medina 2016; Lu et al. 2015). Interviews were conducted by native Mandarin speakers and those conversant in the local dialect. The interviews were semi-structured in that interviewers referred to a scripted interview protocol but had the freedom to investigate specific narratives that emerged. Each interview lasted from thirty minutes to two hours.

Interviewees were divided into two types: demand side stakeholders and supply side stakeholders. Demand side stakeholders included children and caregivers, while supply side stakeholders included government officials, school administrators, teachers, and cafeteria managers and workers. Demand side stakeholders were asked a series of open-ended questions regarding their understanding of NNIP and its implementation. The interviews also sought to understand changes brought about by the program vis-à-vis child dietary habits. In contrast,

supply side stakeholders were asked to elaborate on the program and their role in it. During the interviews, respondents were asked to provide details on the implementation of the program, as well as their thoughts on program challenges and opportunities for improvement.

In the case of both the demand- and supply-side interviews, field notes were subsequently translated into English for inclusion in the qualitative analysis. Each transcript was anonymized such that each interviewee was assigned a number based on location and type of stakeholder. The qualitative analysis was conducted by members of the research team involved in the interviewing process for the sake of consistency in our research. The interview responses were also supplemented with field notes and observations from the research team. The purpose of these field notes was to highlight points of discussion and record information on the thoughts and impressions of the interviewees that could be used in the qualitative analysis. The quotations we present below as evidence are not exhaustive, but were selected to represent the preponderant view of stakeholders on the relevant issue.

V. Qualitative Results

Hypothesis 1: On account of official fraud or misconduct, NNIP funds do not reach children

We found little evidence in our interview data to support this hypothesis. At every school our researchers visited unannounced, students were being served lunch bought with program funds at school every day. No parent or caregiver reported having to pay for these lunches, and all reported being aware of the program. All children interviewed reported that they received a meal in the cafeteria instead of going home for lunch (as they had before the program). All cafeteria staff spoke in detail about their role in the program, and cafeteria managers showed our researchers purchasing records from local food vendors, citing the mandate from the government

to properly account for program expenditures. In one school, children had program funds put on a card they carried with them that they swiped in the cafeteria. Given what we learned and observed from the field, and the generally high public profile of the program, it seems unlikely that a wholesale diversion of program funds is underway.

Hypothesis 2: Budgetary constraints are limiting the NNIP's effectiveness

While it appears funding is reaching the schools, it is not clear whether the subsidy allocated is high enough to realize nutritional gains for students. We hypothesized that a lack of improvement may occur because, as we show next, the true cost of a nutritious lunch exceeds the subsidy amount allocated per student. Both our own calculations of what a nutritious meal would cost and the overwhelming consensus among our interviewees that funding is not enough corroborate this hypothesis.

First, simple calculations reveal that the subsidy per student per day is not enough to purchase a nutritious meal. According to the program, schools receive three to four RMB per student per day to provide a nutritious lunch (Ministry of Education, 2012b). Even if we assume that all these funds are used to purchase food, rather than to cover other indirect costs, the amount is not enough. According to guidelines from China's government, school lunch should account for 40 percent of a child's daily nutritional intake (Ministry of Health, 2017). Based on locally available ingredients (all cafeteria food is purchased by schools locally) and contemporary market prices, such a meal would contain 150g of grains (1.1 RMB), 65g of lean meat (1.9 RMB), 125g of dairy (0.8 RMB), 25g of legumes (0.3 RMB), 150g of fresh vegetables (0.9 RMB), as well as spices, sauce, and/or condiments for flavor (1 RMB). According to this conservative calculation a nutritious meal would cost at least 6 RMB per student per day, or double the allotted amount. For comparison, the Beijing municipal school system spends

between 8 to 10 RMB per student per day for student lunches (Teng et al. 2012). Even when calculating only the direct cost of purchasing ingredients, the three RMB subsidy is well below what is required to purchase a nutritious meal for students.

These shortfalls may be compounded by the fact that the program does not allocate funds for additional direct costs. Rising food and transportation costs were a problem for every principal we interviewed. When these costs are accounted for, there is even less money available to purchase nutritious meals for students.

“As a remote school, our costs of transporting food are high and getting higher.”
[Principal, 322051S1]

“The price here is higher because it’s farther--we don’t have a market close by. We have to go up the road to go buy things. It’s more expensive than other places in this prefecture. The standard of the program is the same everywhere but that does not account for how far away our school is from suppliers.” [Principal, 333031S1]

“In the local markets, vegetables and meat are becoming more expensive with each year that passes.” [Parent, 333051P1]

“The price of several vegetables and the foods needed for this program has been steadily rising over these past years.” [Teacher, 333051T2]

“Over the last five years, flour has doubled in price, [the price of] rice has gone up by 66%.” [Mother, 322051P3]

As the subsidy is not adjusted for increases in transportation or food prices, the shortfall is likely to worsen as transportation and logistic costs undoubtedly will continue to rise.

Limited budgets may also cause administrators to buy cheap, non-nutritious foods in place of nutrient-rich foods. For instance, administrators reported commonly purchasing fatty pork instead of lean pork. This approach is problematic because fatty pork lacks the nutritional content of leaner meat, and can be unappetizing.

“There’s not enough money. We can only purchase fatty pork. Our main focus is simply to have students eat their fill, not necessarily eat well.” [Teacher, 322051T1]

“There’s not enough money. We can only purchase fatty pork, vegetable preserves and starches ”

[Cafeteria manager, 322051C2]

“The amount of meat served has increased, but the budget is not enough to buy much lean meat. So we buy fat meat, which many students do not like eating.” [Principal, 325051S1]

Lack of variety in foods served at school was also something that administrators and teachers ascribed to limited budgets. With a modest subsidy on hand, schools can offer only limited menus, serving repetitive meals that may lose their appeal as students are served the same foods week after week.

“Because there are only around 5-6 choices for the menu, and we must cycle through the choices, there is a large possibility that students will tire of the food after a while.”
[Teacher, 333031T1]

These quotes and others indicate a clear problem standing in the way of the NNIP’s desired outcomes. Insufficient funding results in unappetizing, non-nutritious and monotonous meals that students may reject or at least not fully consume.

Summarizing the frustrations many seemed to feel about the lack of funding, one principal suggested doubling the subsidy per child by eliminating the subsidy for children in more well off areas.

“Here’s what I think they should do. Obviously the subsidy is not enough. The province puts in one more RMB per student per day but that is still not enough. What they should do is stop giving the subsidies in the county seat (县城), and combine that money with the subsidy for the rural areas (乡镇). Everyone knows the county seat students don’t need the subsidy, it’s the townships that need it. But we can’t change the policy at this level.”
[Principal, 333031S1]

Ultimately, our own calculations and the overwhelming consensus from interviewees with knowledge of the subsidy amounts show that the subsidy may be too small. This problem is

compounded by the rising costs associated with food price inflation, meal logistics, and transportation. Administrators attempt to deal with the shortfall by purchasing substandard ingredients for school meals. Whether because ingredients are too few, insufficiently nutritious, or both, it seems reasonable based on our qualitative data to conclude that the inadequate subsidy contributes to the failure of the program to improve student nutrition.

Hypothesis 3: Administrative shortfall limits effective implementation of the NNIP

As with the budgetary constraints, without exception school administrators complained about the administrative burden of the NNIP. The organizational tasks associated with the program appear to be a significant drain on school administrators, who often do not have the time or extra staff necessary to perform the tasks effectively. Because the NNIP does not allocate funds to hire extra staff to carry out the program, an administrative shortfall may be affecting the quality of the food served.

In response to interview questions about administrative workload, all the principals we interviewed expressed exasperation with the amount of time required to implement the NNIP. At every school our researchers visited, teachers spend hours each day managing the cafeteria and filling out paperwork, while some are even appointed as full time NNIP implementation managers.

“Implementing the program is an enormous amount of work. I now have five out of my seventeen staff working on this. I spend about thirty percent of my time working on it, my deputy spends about half his time on it. Then we have a teacher that works full time administering the program, from record keeping, procuring, and generally organizing things. Then there are two kitchen staff who are working full time.” [Principal, 333031S1]

Thus aside from the delivery, preparation and serving of the food there are significant manpower costs associated with record keeping and organization. These burdens cannot but fall on teachers and principals.

“I think this nutrition program is important. I want to help. I want to do a good job implementing it, but the situation is simple: I can’t do it. I don’t have enough staff, I don’t have enough time. But what can we do? This is a policy. We must carry it out.”
[Principal, 322051SI]

Principals also report that the program makes worse the already chronic shortage of teaching staff in rural schools.

“I don’t have enough teachers to teach the basic curriculum here. Everyone knows rural schools lack teachers. That’s our number one problem. And now we have this lunch program to implement, and there’s no staff for it. Of course we have to use our own teachers for it. I know the kids need it, and I know the parents like the policy. But I can’t use teachers to implement it. They don’t like doing it and are overburdened with teaching work already. But I have no choice.” [Principal, 333051SI]

Cafeteria staff are also feeling the crunch. Since the launch of the program they have seen a large increase in their workload with the rise in cafeteria patrons—children that used to eat lunch at home:

“Before the program we had 45 people eating per day in our cafeteria, students and teachers. Now there are 115 students eating in the cafeteria each day. Where are the extra cooks?” [Cook Manager, 322051C1]

Without a commensurate rise in staff to match the rise in demand for food, short-handed cafeteria managers may not be in a position to prepare nutritious meals.

Due to the administrative shortfall both among regular and cafeteria staff, overwhelmed administrators can cut corners by contracting out food preparation to local private companies. Program rules prohibit hiring outside contractors to prepare and serve the food, but by apparent logistical necessity such contracts happen anyways.

"The rules from above state that schools cannot contract out their kitchens, so many are ending those kinds of arrangements. On the surface, the schools are ending the agreements with contractors but in reality they are still using them -- schools can't do it themselves." [Principal, 322051S1]

Worth noting is that contracting out kitchen work may introduce another layer of complexity. In addition to legality concerns, the possibility of profits on the part of contractors may lead them to compromise the quality of foods prepared for students.

In short, not one principal or cafeteria worker interviewed expressed satisfaction with the human resources they have to carry out the NNIP in their schools. They complained universally of being short handed, and were resentful of the additional burden placed on staff to carry out the program. It is possible that this shortfall is indeed affecting the quality and quantity of food prepared for student consumption.

Hypothesis 4: Insufficient expertise has hindered the provision of nutritious meals

In addition to the budgetary and administrative shortfalls, inadequate nutritional and professional expertise may lead schools to serve non-nutritious meals to students. Our interviews bear out this hypothesis, revealing that many of the individuals charged with determining the content and preparation of meals were at a loss insofar as what constitutes a healthy, balanced meal.

This lack of expertise was quite clear at the county government level. An official in the education bureau of a county in Hanzhong prefecture who is in charge of supplying nutritious meals to more than 31,000 children reported:

"There's not a single nutrition professional in the entire prefecture: everyone follows their instincts while setting school menus." [Director of the School Lunch Program Implementation Office (325051D2)]

If that were true, it would mean there are no nutritionists in the entire prefecture, a heavily rural region with 3.7 million residents and as many as 300,000 rural school-age students. Decision makers at the county level expressed exasperation at the thought of providing nutritious meals, complaining that they had neither the skills or the mandate to ensure healthful meals.

“Our county education bureau has designated a special team to coordinate and carry out the nutritional improvement program. We have four people here whose only job is to oversee this policy. I don’t think another county in this prefecture, maybe even in this province, has put as many staff resources into trying to make this work well. And you know what? We still don’t know we’re doing. We don’t have the background experience.” [Deputy Director of the School Lunch Program Implementation Office (325051D2)]

Another county level official shared this sentiment, and even asked our enumerators if they could report the failings of the program to the authorities so that the NNIP could be scrapped.

“I’m going to tell you about this policy in our county. Our county was selected to serve as a pilot county to test out a new way to deliver the nutritional lunches. We received funding from above (上面) to build a central preparation kitchen. They will cook food centrally and deliver it to schools by van. We’ve spent 50 million RMB building this facility, and let me tell you it is a complete waste (劳民伤财). Originally it was planned to serve all 30 schools in the area. After pouring money into the building, and taking into consideration the issue of food safety, which is more complicated than anyone here realized, it will only serve 9 schools. Are you from the central government? I don’t know who thought of this policy but can you tell them stop or adjust this policy?” [Deputy Director of the School Lunch Program Implementation Office (325051D2)]

In this way, all county level officials expressed impatience with the NNIP, characterizing it at best as well intentioned but beyond their capacity to run properly and at worst a boondoggle.

At the school level, no school administrator interviewed provided any indication that they received training or guidance on how to prepare balanced or nutrition meals. The statement below is typical of their responses to this line of inquiry.

“We received this nutrition handbook when the program began in 2012, but we have not ever consulted it. I don’t know if it is helpful.” [Principal, 325051P1]

"I am a teacher. I teach math and am the school groundskeeper. In the past two years I also help administer the nutrition program. But what do I know about nutrition? The children are happy to eat—that's what's important. That's what their parents care about. This is a simple place we don't have complex ideas about nutrition." [Teacher, 333031T1]

The absence of training or awareness of nutritional best practices is evident among those who prepare the food as well. In no school that our researchers visited for qualitative interviews did the cooks working the cafeterias and making the lunches receive nutritional training, though in some cases they reported that training was promised but never delivered.

"We didn't receive any training about nutrition. The principal said he would send us to a training program but we never went." [Cooks, 333031C1 and 333031C2]

Ultimately this nutritional ignorance poses a fundamentally different kind of barrier to the NNIP's success than the budgetary or staffing shortage. Even if the program were to allocate sufficient funds and people to serve nutritious meals, without nutritional expertise on hand these resources could be wasted.

Aside from the shortage of available knowhow on nutrition, interviews also show that the preoccupation of administrators with food safety may have distracted them from focusing on meals' nutritional content. It was clear, for instance, with county level officials that the priority issue in monitoring the program was food safety, not nutritional content.

"We're not trained for this. I can inspect schools, try to make sure the kitchens and cafeterias meet the right standard. But I don't know a thing about nutrition. Besides, no one cares about nutrition. They only care about food safety. That is what the government cares about. That is what our team is held accountable for. So naturally that is what I focus on. But nutritious food? Who knows. I focus on safety—that's hard enough already. There's no punishment for serving non-nutritious food." [Deputy Director of the School Lunch Program Implementation Office (325051D2)]

Principals at schools, who are ultimately liable if their children get sick from the food they eat, confirmed the emphasis placed on the maintaining food safety and expressed anxiety about shouldering the new responsibility.

“If things are under my control then it’s my fault. [There are] definitely risks, especially food safety: that’s the sword above my head. If there is any kind of food problem—for example, if students get sick from food—I go straight to jail.” (Principal, 333031P1)

The principal quoted above required that small samples of each dish served for lunch be painstakingly labelled and refrigerated for two days, so that if a student fell ill he would have plausible deniability to show that food was not the cause of the illness. Here, the already-large manpower cost of program implementation increases with the need to implement a measure that does not even contribute to nutrition: the sole purpose of the food refrigeration is to protect the school from liability for food poisoning. Interview findings illustrated how food safety fears crowd out nutritional concerns.

“There are too many restrictions. I’d like to give the students more variety in their meals, but there’s a strict limit on what kinds of foods I can buy on account of food safety regulations.” [Cook, 333051C2]

For example, county level administrators confirmed that such regulations outlaw tofu, which is rich in iron content (United States Department of Agriculture 2016) and fresh fruit, which contains Vitamin C, essential to iron absorption (Iron Disorders Institute 2017):

“Schools are not allowed to serve tofu or fruit, because of the danger of foodborne illness. We have to make sure no one gets sick, so we are conservative about ingredients. After all we don’t want to be held responsible if children get ill from food procured locally.” [Director of the School Lunch Program Implementation Office, 325051D3]

As such, both a lack of knowledge about nutrition and restrictive food safety guidelines limit meal variety and nutritional makeup.

Our interviews make clear that although funds appeared to reach schools in order to implement the NNIP, major shortfalls in the program were evident and could easily limit the program's effectiveness in raising nutritional outcomes. In total we interviewed 37 people involved with the administration of the NNIP, and not one seemed happy with having to carryout this policy. They uniformly portrayed the program as well-intentioned but extremely burdensome to implement effectively for want of funding, manpower, and expertise.

VI. Conclusion

In this paper we conduct the first-ever comprehensive analysis of the NNIP and its impacts, bringing together large-scale survey data from before and after the program's implementation with qualitative interviews from stakeholders at every level of the NNIP. We show that the population-weighted average anemia rate across Shaanxi, Gansu, Qinghai, and Ningxia provinces increased from 19 to 25 percent after the implementation of the NNIP. In addition, the prevalence of students below the average height for age z-score increased from 72 percent to 82 percent, and more students (from 20 percent to 24 percent) were below the normal BMI according to international standards. Consumption patterns of food changed only slightly and unevenly before and after the program, and meals served under the program fall well short of nutritional guidelines, providing less than 20 percent of a student's daily nutritional needs instead of the mandated 40 percent.

Our qualitative interviews reveal possible factors that may play a role in the apparent failure of the program. The interviews make clear that at the very least authorities seem to have established mechanisms to ensure that NNIP program subsidies reach schools and children. However, the subsidies alone are insufficient to cover the direct costs associated with purchasing enough healthful foods to serve children. What is more, the funds do not appear to be enough to

cover rising transportation and food costs, potentially limiting the amount of high quality food that can be purchased from vendors. Indirect costs also appear to be prohibitive, because staffing at the school and county levels does not appear to have risen in tandem with the increased amount of work required to implement and oversee the program. Finally, the interviews reveal insufficient expertise on the part of program implementers to provide healthful, balanced meals to children. It is possible that each of these factors curb the potential of the program to some degree, compounding one another and ultimately rendering the program ineffective in addressing the nutritional deficiencies children served.

While a reasonable point of departure for improving the program would simply be to raise the per student subsidy, our qualitative findings suggest funding is not the only problem, and hence more funding is not the only required solution. Additional administrative capacity, a bureaucratic emphasis on nutrition rather than food safety alone, and earmarks to support local nutritional expertise would all seem to be important innovations to the current program. Despite these shortcomings, however, the promise of a school-based nutritional improvement program is real. The NNIP should be reinvigorated to address the startling nutritional deficits common among children in China's rural areas.

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Table 1. Distribution of sample schools, students, across provinces

	Pre-program datasets			Post-program
	Dataset 1	Dataset 2	Dataset 3	Dataset 4
	(1)	(2)	(3)	(4)
Survey time	MAY 2010	JUN 2010	JUN 2011	MAY 2015
Number of counties	10	10	25	38
Number of school	77	79	300	100
Number of students	8,904	3,124	21,107	7,388
Sample provinces				
Qinghai	X		X	X
Ningxia	X			X
Shaanxi		X	X	X
Gansu			X	X

Data source: Authors' surveys

Table 2. Stakeholders interviewed during qualitative data collection

Stakeholders	Number
County officials	6
Principals	4
Vice Principals	2
Teachers	10
Cafeteria-supervising Teachers	7
Cooks	7
Students	7
Parents/Caregivers	15
Total number of interviewees:	58

Data source: Authors' surveys

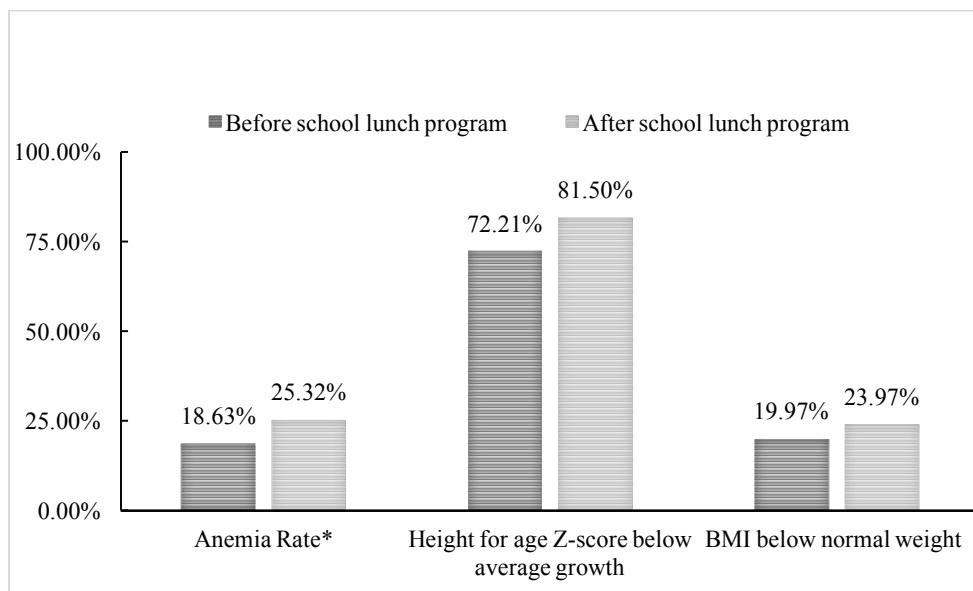


Figure 1. Student health status before and after school lunch program

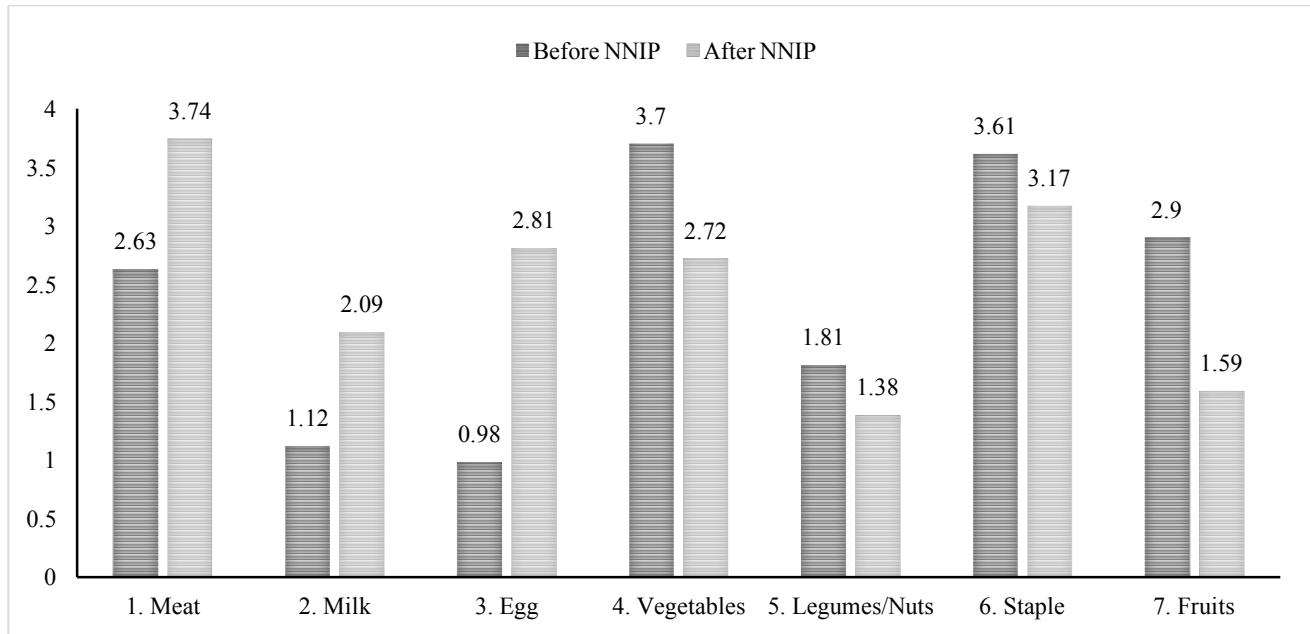


Figure 2. Student food intake frequency before and after NNIP

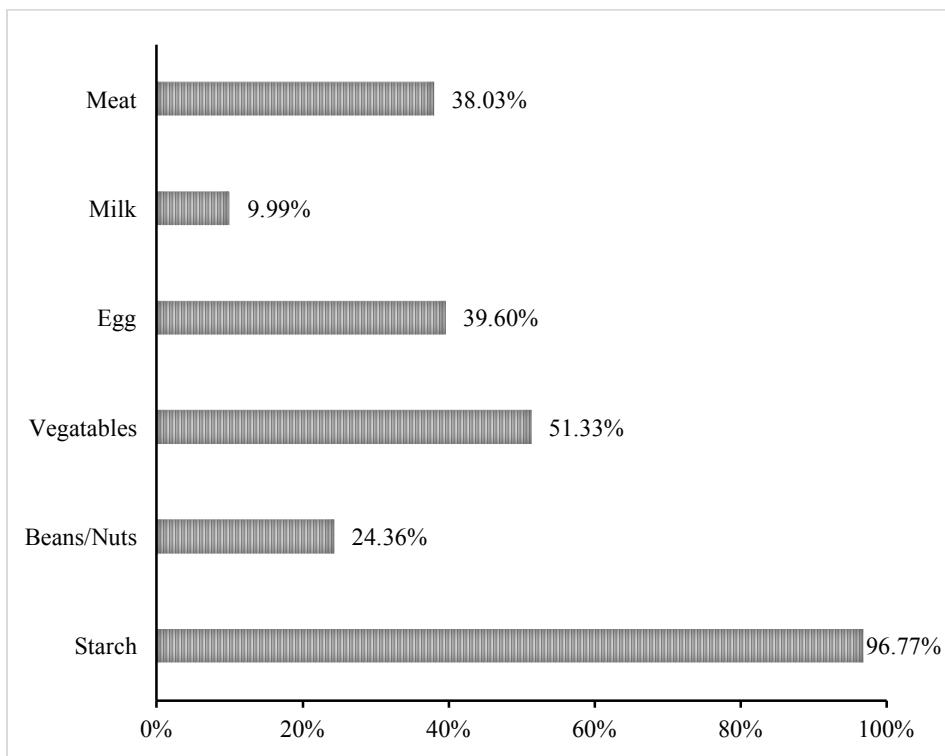


Figure 3. Average school lunch intake as of percent of national school lunch guidelines.