Public Transfers and Intra-household Resource Allocation: Evidence from a Supplementary School Feeding Program*

Farzana Afridi†
University of Michigan, Ann Arbor
September 27, 2005

*I am grateful to Julie Cullen, David Lam, Albert Park and Rohini Somanathan for their continued guidance, support and encouragement. This paper has benefited from the comments of and discussions with Bill Axinn, Charlie Brown, Jean Dréze, John Maluccio and Santosh Jain Passi. I am particularly indebted to Santosh Jain Passi for her advice on the design of the nutrition survey, in the training of the field workers and in the computation of nutrients. Thanks also to Kajali Paintal, Rajeshwari Ramana and Jharna Dasgupta for providing their expertise in the implementation of the nutrition survey and the analysis of the consumption data. I would also like to express my gratitude to the district administration of Chindwara, particularly Malay Srivastava, for its cooperation in the conduct of the survey. Participants at the Public Finance seminar at the University of Michigan provided valuable inputs for improving this paper. This research was supported by a Pre-dissertation Fellowship from the Population Council, New York. All remaining errors are mine.
†Department of Economics, University of Michigan, 611 Tappan Street, Ann Arbor, MI 48109.
Email: fafridi@umich.edu

Abstract

How effective are public transfer programs, targeted at a single household member, in improving the welfare of that individual if the unitary household redistributes its resources in response to the program? This paper draws upon unique survey data on a supplementary school meal program in India to answer this question by assessing the proportion of the nutrient transfer that sticks to a child's daily intake. I use a series of empirical methodologies which approach the ideal of randomized program evaluation and are based on two sources of identification: randomization of the children's 24 hour consumption recall between school and non school day and variation in the quality and quantity of the school meals. I find that the daily nutrient intake of program participants increases by between 49% and 100%, indicating that for most of the nutrients the transfer does not stick to the child one-for-one. However, the point estimates are not statistically significantly different from 1, particularly when I account for endogenous program participation through a community and individual fixed effects models. Thus, for as low a cost as 1.33 cents-2.97 cents per child per school day the school feeding program reduces the daily calorie deficiency of the average primary school going child in the survey region by almost 35%, the daily iron deficiency by 25% and meets almost their entire daily protein deficiency.

1 Introduction

The improvement of individual well being is one of the primary objectives of most welfare programs. Policy initiatives in developing countries often aim to address the challenge posed by low levels of education and health among the vulnerable sections of its population, particularly women and children. A relevant policy question is to what extent the intended beneficiary of public transfer programs benefits from such policy initiatives. The standard unitary model of household behavior (Becker, 1974) suggests that as long as the household is the final decision making unit, transfers to an individual member are equivalent to an increase in total household resources. If households pool their income and redistribute it among their members, intra-household resource reallocation in response to a welfare scheme targeted towards individuals would lead to smaller than expected gains to the recipient of the transfer. In this paper I test this implication of the unitary household model by analyzing the impact of a supplementary school feeding program on a child's daily consumption of nutrients in India. I also investigate the factors that determine the magnitude of reallocation of household resources, if any, away from the child in reaction to the transfer program.

Besides evaluating the efficacy of individual welfare programs in general, the estimation of the magnitude of the impact of school meal schemes on child nutrition is a goal in itself. South Asia accounts for the largest proportion of pre school children suffering from stunting and wasting in the world, 40% of whom come from India[1]. Stunting in early childhood is linked to low levels of mental development and increased susceptibility to diseases in later stages of life (Report of the Commission on Nutrition Challenges in the 21st Century, UNICEF, 2000). Policy interventions which promote catch-up growth could lead to improvement in mental and physical well being as well as a variety of other non-health outcomes of the of school age children[2].

Surprisingly, there exists little evidence about the effectiveness of school feeding programs in improving child nutrition in developing countries. The literature on public transfers to children, in general, has focused primarily on indirect outcome measures such as aggregate household consumption, long term health or test scores. While these outcomes are a crucial element in the success of these schemes, they do not account fully for the redistribution of resources within the household. This study is the first attempt at analyzing the effectiveness of the supplementary feeding program in India, benefiting more than 50 million children in about 400 thousand public primary schools across the country, in improving daily nutritive intake and reducing malnourishment.

[1] Report of the Commission on Nutrition Challenges in the 21st Century, (UNICEF, 2000). Moderate to severe wasting is defined as below -2 standard deviations from median weight for height of reference population and stunting is defined as below -2 standard deviations from median height for age of reference population.

[2] A review of experimental and survey research by Behrman (1996) concludes that most studies have found evidence of a positive relationship between children's nutritional status, their cognitive achievement and school participation rates.

I address both the broad and the more narrow research question by drawing upon unique primary survey data that I designed and collected in the central Indian state of Madhya Pradesh. This custom-designed survey provides individual consumption data on daily intake of essential nutrients of children through a 24 hour recall survey enabling a direct measurement of the magnitude of nutrient transfer through the school meal program and how much of this transfer sticks to the child. Though the ideal strategy for determining the true impact of the meal program on nutrient consumption would be through a random assignment of children into the scheme, in this paper I use a series of empirical methodologies which approach this ideal through a progressive relaxation of the assumption of exogeneity of program participation. First, assuming exogenous assignment of all eligible children into the program across the survey region, I use the randomness in whether the child's diet recall was for a school or non-school day to identify the impact of the program on daily nutrient intake. The randomization of the date of interview in the survey design provides this exogenous determinant of daily individual participation in the program.[3] However, not all communities had implemented the feeding program during the survey period. I, therefore, relax the assumption of random participation of children across communities by analyzing a within community model, assuming heterogeneity in the unobservable characteristics of the communities which might influence program participation as well as a child's nutrient consumption.

Finally, I approximate random assignment of individuals into the meal program through a child fixed effects model. The survey data include a panel of randomly chosen sub-sample of children whose dietary recall data were collected on two consecutive days – on a day they were provided a supplementary meal, a school day and a day on which they received no food transfer, a non-school day. Comparison of the nutrient intake of the same child on these two days would provide the most accurate estimate of the scheme's effectiveness by accounting for unobservable individual characteristics which might affect daily nutrient consumption.

To give a brief preview of the results, the point estimates for the quantity of nutrient transfer through the program are in the range of 49%-100%, indicating that for most of the five nutrients analyzed the transfer does not stick to the child one-for-one. However, these estimates are not statistically significantly different from 1. Therefore, we can't reject the hypothesis that there is no substitution of nutrients away from the child in response to this transfer. A disaggregation of the total daily consumption data into intake of nutrients during school and non-school time strengthens this conclusion. The estimate obtained from the community and individual fixed effects model are not statistically significantly different from 1 for almost all the nutrients, suggesting that the nutrient intake of the child rises by full amount of the transfer during school time meals. The effect of nutrient

[3] In rural India, as in the survey region, there are large seasonal variations in household food security (Behrman and Deolalikar, 1989). If a comparison is made of nutrient intake between school and non-school days across seasons with different levels of food availability, the estimate on the program effect may be biased. However, this survey was conducted within a period of two months during which there was no seasonal variation in food security of households in the survey.

transfer on consumption during non-school time is insignificant, indicating that families do not redistribute food away from the participating child during meals after or before school.

An analysis of factors that determine resource reallocation within families, surprisingly suggests that there is no gender discrimination in the extent of resource redistribution in response to the transfer. However, a larger proportion of the transfer sticks to younger children and those belonging to smaller families. Interestingly, the larger the total transfer to siblings residing with the family from the supplementary feeding program, the greater the proportion of the transfer sticking to an individual recipient. But poor households are more likely to substitute nutrients away from a child participating in the program relative to rich families.

From a policy perspective, these results indicate that transfers through public programs targeted at individuals can almost entirely benefit the intended recipient, rejecting the implication of the unitary household model. In the case of the school feeding program in India, for as low a cost as 1.33 cents-2.97 cents per child per school day the scheme reduces the daily calorie deficiency of a primary school going child in the survey region by almost 35%, the daily iron deficiency by 25% and meets almost the entire daily protein deficiency. Thus, in the short-run the program can have a substantial effect on reducing hunger at school and protein-energy malnutrition while the long-term implications of these results for child health and economic well-being may also be significant.

The remaining paper is organized as follows. The existing literature, the analytical framework and the background of the school meal scheme in India is discussed in section 2. The details of the design and implementation of the survey and the data are presented in section 3 along with the empirical strategy. The empirical results are presented in section 4 while section 5 discusses the policy implications of the results and concludes.

2 Background

2.1 Existing Literature

The motivation for research on intra-household resource allocation stems largely from the work of Becker (1974). There exists a large literature which tests the theoretical predictions of the unitary household model on intra-household resource allocation. Many of these studies have analyzed the impact of public welfare programs on private, intra-family transfers. For instance, Jensen (2003) finds that one rand of public pension to the elderly in South Africa resulted in a 0.25 to 0.30 rand reduction in transfers from non co-residential children. Rosenzweig and Wolpin (1994) observe that an increase in AFDC (Aid to Families with Dependent Children) benefit to daughters reduces in-kind transfers in the form of shared housing as well as direct financial transfers from parents. On the other hand, if parents make transfers to children in exchange for their services rather than due to altruism motive, empirical evidence suggests (Cox, 1995; Altonji et al., 1997) that public transfers will not neutralize parental transfers.

The literature on public interventions in child health and education, however, has been restricted mostly to providing indirect evidence of whether public transfers stick to the child (Behrman and Hoddinott, 2005; Das Gupta et al., 2004 on *long term child health*; Vermeersch and Kremer, 2005; Schultz, 2004; Kremer et. al., 2002; Dreze and Kingdon, 2000 and Ravallion and Wodon, 2000 on effects on *school participation*; Vermeersch and Kremer, 2005; Martorell, 1993; Sheshadri and Gopaldas, 1989 and Soemantri, 1989 on *cognitive ability*; Long, 1991 on *household food expenditure*). Some of the experimental studies are based on small and at times selective samples and may not account for possible reallocation of resources within households which may affect outcomes. The survey studies, on the other hand, usually suffer from sample selectivity and endogenous program participation. In addition, though extensive evidence exists on inequality in allocation of resources within a household on the basis of gender, earnings capacity and other individual characteristics (Pitt, Rosenzweig, and Hassan, 1990; Behrman 1988; Rosenzweig and Schultz, 1982), studies on the implication of this literature for the magnitude and determinants of intra-household resource allocation to individual recipients of government transfer programs have been few.

On-site supplementary meal schemes provide a good case for studying household dynamics since it is difficult to control for the final recipient of transfers through a take home public transfer and may get complicated by bargaining issues[4]. Despite these advantages and the growing emphasis on supplementary feeding programs in developing countries, the literature on this scheme is scant.

In the U.S., however, there has been considerable research on evaluating the impact of the National School Lunch Program (NSLP) and School Breakfast Program (SBP) (Akin, Guilkey and Popkin, 1983; Devaney and Fraker, 1989). They find small benefits of the program on the 24 hour intake of nutrients for participating children. But these studies do not account for sample selection either at the individual or school level. More recently, Gleason and Suitor (2003) using an experimental approach, compare the difference in mean nutrient intake of participants on a school day with the difference on a non-school day to find positive effect of the NSLP on daily nutrient intake. However, none of these studies quantify the nutrient transfer through the school meals.

But for developing countries, quantitative evidence on impact of on site school feeding programs on individual daily intake is very inadequate (Allen and Gillespie, 2001; Beaton and

[4] The income pooling models contrast sharply with the bargaining literature which suggests that resource allocation within households is determined through a process of bargaining between individual members. Thus, a government transfer directly to a particular household member could potentially increase his or her bargaining power resulting in an allocation of household resources closer to the preferences of the recipient of the transfer (Lundberg, Pollak and Wales, 1997; Duflo, 2003; Martinelli and Parker, 2003; Aromolaran, 2004). In this scenario, the impact of the public transfer would be the sum of the resulting income effect and the increase in individual bargaining power.

Ghassemi, 1982). Jacoby et al. (1996) find increase in dietary intake of energy, protein and iron of fourth and fifth grade children randomly assigned to the treatment group in a school breakfast program in Peru. A more recent study by Jacoby (2002) on a school meal program in the Philippines examines a similar question on the impact of transfer of calories through the meal program on the daily calorie consumption of participating children. Using the randomness in the assignment of school and non-school day to respondents within the same school, he finds no evidence of a reallocation of calories away from the child within the household in response to the feeding program.

In this paper I go beyond the Philippine study by assessing the transfer of nutrients other than calories since the *quality* of the school meal might be an important factor and as a result households might reallocate other nutrients in response to the public transfer if not calories. In addition, I implement a more rigorous test of the program's success through an individual fixed-effects model that controls for unobserved heterogeneity which may be correlated with program participation and the quantity and quality of the transfer.

2.2 Analytical Framework

It is reasonable to assume that during early childhood the consumption of a child residing within a household is almost completely within the control of parents. We can, then, analyze the impact of a public transfer to the child within the unitary framework of the household. Consider a two member household consisting of parent *i* and child *j*. The household maximizes its utility over two goods, total daily consumption by *j* of the good subsidized by the public transfer, C^j and a vector of other goods **X**, which includes daily consumption of non-subsidized goods by both *i* and *j*. The quantity of C^j and **X** consumed is a function of the individual characteristics of the household member, μ^k (such as age and gender), η^h is a vector of household characteristics (such as, demographic composition of the family, religion and caste) and η^c represents community characteristics (such as, level of healthiness of the population and implementation of school meal program) which might influence consumption of goods. The household's utility maximization problem is,

$$\text{(1)} \qquad \text{Max.} \quad U = U(C^j, \mathbf{X}\ ; \mu^k, \eta^h, \eta^c) \qquad k = i\ ,j$$

subject to the household budget constraint over a day,

$$\text{(2)} \qquad \mathbf{X} + \mathbf{p_c} C^j \leq Y$$

where, $\mathbf{p_c}$ is the price of C^j relative to price of **X** and *Y* is the total daily household income. For simplicity, I assume that prices of both C^j and **X** are exogenous to the household. The first order condition with respect to C^j and **X**, leads to the condition,

$$\text{(3)} \qquad \frac{MU(C^j)}{MU(\mathbf{X})} = \mathbf{p_c}$$

Equation (3) is the usual utility maximization condition which states that the household will equate the marginal rate of substitution between C^j and **X** to the ratio of the prices of the two goods. The household's utility optimization generates the following optimal demand functions for C^j and **X**,

(4) $$C^{j*} = \text{C}\,(\mathbf{p_c}, Y, \mu^k, \eta^h, \eta^c)$$

(5) $$\text{X*} = \text{X}\,(\mathbf{p_c}, Y, \mu^k, \eta^h, \eta^c)$$

On a school day, the child receives an in-kind transfer through the school meal program. I assume that the meal program does not affect the relative prices of the two goods $\mathbf{p_c}$, but only has a general income effect. Keeping the right hand side of Equation (3) constant and given the neo-classical properties of the utility function, the household will increase the allocation of resources to **X** in order to correct the imbalance in the equality resulting from an increase in C^j from the consumption of meals at school. The theoretical model, then, implies that the increase in the child's daily nutrient intake may not be by the full amount of the transfer from the school meal on a school day due to the reallocation of household resources. Conceptually, a difference between a child's total daily nutrient intake on a school versus a non-school day would identify the magnitude of the transfer that sticks to her, since there would no resource reallocation on days the child does not receive a transfer.

However, this experiment hinges on two critical assumptions about school and non-school days. First, there should be no systematic difference in nutrient intake between these two days. In agricultural economies, as in the survey region, children usually work on the family farm or perform household chores. If children work more on non-school days and therefore have higher nutrient requirement and consumption on these days, then the difference between nutrient intake on these two days would be small. This would bias the program effect downwards. However, one of the strengths of the data is that I can directly measure the time utilization pattern of children on school and non-school days. I find no systematic differences in the number of hours spent by children in performing different chores on these two days, as elucidated in a later section. Further, the non-school days were not on festivals on which food intake is higher relative to school days. Additionally, the public primary schools are located within the village premises and are a few minutes from the homes of enrolled students[5]. Children could, therefore, go home during the school lunch break to have a meal, potentially reducing differences in total and during school hours nutrient intake between the two types of days as well as between children attending schools with and without the meal program.

Second, nutrients obtained from the school meal should be fungible only within a day and not between a school and a non-school day for the experiment to provide the true program effect. In the surveyed area, a school week consists of six days, from Monday through Saturday. It is plausible to assume that the household would smooth the child's consumption over a day rather than tax her

---

[5] See Figure A1 in Appendix for a map of a typical surveyed village.

consumption only on a non-school day. However, a large income effect would bias the effect of the meal program on daily nutrient intake downwards if one compares school and non-school days. A back of the envelope calculation, though, shows that the meal transfer accounts for only about 2.4 – 3.6 percent of total monthly food expenditure of a household with a single recipient of the transfer[6].

2.3 The School Feeding Program in India

I now turn to explaining the nature of the school meal program in India in order to understand the empirical strategy described in the next section. The federal government in India launched the National Program of Nutritional Support to Primary Education in August 1995 (Government of India, 1995). Under the program, cooked meals were to be introduced in all government, local body and government aided primary schools across all states in the country within two years. In most Indian states primary school consists of grades 1 to 5 with a few exceptions, in which case primary school is only up to grade 4. All enrolled children in these schools were to be provided with a free 'nutritious' meal equivalent to 100 grams of calorific value per school day. The federal government was to provide raw food grains (either wheat or rice, depending on whether it is a wheat or rice eating area) free of cost to the state governments. The cost of converting raw food grains into cooked meals was to be borne by the state governments. States were given an interim period to raise resources to implement the program. In the meantime, they were allowed to distribute free grain rations to all enrolled children at 3 kilos per month for a 10 month academic year subject to a minimum monthly attendance of 80% per student. A supreme court of India judgment in November 2001 directed all state governments, which were yet to implement the program, to provide cooked meals in all targeted schools in the state within six months[7].

2.3.1 The School Feeding Program in the Survey Region

This survey was designed and conducted by the author in one of the largest states of India, Madhya Pradesh (MP), located in the central part of the country. According to the National Family Health Survey (NFHS), 1998-99, more than 50% of children in MP are underweight, higher than the national average of 47%. The school meal program is, thus, of considerable significance for this region.

---

[6] Data on monthly food expenditure of the households in the survey and on the official guidelines for per child expenditure for the school meal program were used in obtaining this rough estimate.
[7] Quoting the Supreme Court order; "We direct state governments/union territories to implement the mid-day meal scheme by providing every child in every government and government assisted primary school with a prepared mid-day meal with a minimum content of 300 calories and 8-12 grams of protein each day of school for a minimum of 200 days. Those governments providing dry rations instead of cooked meals must, within three months, start providing cooked meals in all government and government assisted schools in half the districts of the state (in order of poverty), and must within a further period of three months extend the provision of cooked meals to the remaining parts of the state."

The survey was conducted from January through February 2004, in one of the eleven census blocks of Chindwara district of MP[8]. Chindwara is located in South Central MP and is one of the largest in the state with a population of almost 2 million in 2001. In the survey block public schools were providing raw food grains at 2 kilos per month to all enrolled students equivalent to 100 grams of raw food grains provided under the cooked meal program for 200 school days before the new academic year beginning in July 2003[9]. The cooked meal program was initiated in July 2003 based on guidelines provided by the state government, presenting a good case for studying the immediate impact of the program on the target population. This was also one of the 120 economically deprived census blocks in the state in which a new 'improved' meal program was introduced on a pilot basis in February 2004 by a newly elected state government[10]. Thus, an exogenous variation in meal quantity and quality was introduced in the program.

However, the implementation of the program was not uniform across the survey area. The directly elected village or gram panchayat (GP) which is the administrative body at the village level has the primary administrative and financial responsibility of implementing the school meal program in all the public primary schools within it purview in the survey region. Each GP represents at least 1,000 people, typically consisting of residents of one to three villages. The sarpanch (president) of the GP who is directly elected is primarily responsible for all decisions made by the GP. While some GPs had implemented the feeding program in schools within its jurisdiction others had not, possibly due to some unobservable political and financial reasons, during the survey period. Due to the democratic nature of this program enforcing body, therefore, the implementation of the school meal scheme was most likely endogenous to that particular GP.

3 Data and Empirical Strategy

3.1 Survey Data

Within the selected census block, 41 villages were chosen randomly for a survey on an *exogenous* interview date. Within each village, 15 households were surveyed through systematic random sampling. The randomly selected household was interviewed only if a child in the age group of 5-12 resided in it, including any child more than 12 years of age currently enrolled in primary school[11]. Though, officially primary school going age is 6-10 years, because there could be early enrollment or

[8] In India each state is divided into districts. Each district is further subdivided into census blocks. In 1991, there were 45 districts and 459 census blocks in MP.
[9] The school academic year in the sampled district is for 10 months from July to April. Each school month consists of approximately 20 school days, constituting a total of 200 school days in a year.
[10] Under the initial school feeding program, schools were to provide 100 grams of *wheat porridge* (either sweet or salty) such that a total of 413.80 kcal and 8.20 grams of protein are provided per student per school day. With the initiation of the new pilot program in February, the targeted schools were to provide all enrolled children with 100 gm of *wheat bread* (roti) along with either 60 grams of *vegetables* or 20 grams of *lentils* per child per school day. See Figure A2 and Table A5 in the Appendix for a description of the history and the cost of the program in MP.
[11] Approximately 2% of the sample consists of children who are in the age group 13-14 and enrolled in a primary school.

repetition of grades, I chose a broader age group. If no child in this range of age resided in the household it was replaced by the household immediately in front of it, if the target population resided in it, otherwise the household immediately behind it was sampled, and so on[12].

In each household all children in the target age-group were administered a food consumption and activity recall survey for the previous 24 hours on the randomly chosen interview date. Children in all the sampled households in a particular village were interviewed on the same day. In some villages, the previous day was a school day while for others it was a school holiday. Thus, children in some villages recalled their consumption on a school day while those in other villages recalled their diet on a non-school day. Using standardized household utensils, children were asked what and how much food they consumed from the moment they woke up the previous morning to the time they went to bed the previous night[13]. Specific questions were asked on whether they attended school, were offered a meal at school and if they consumed it. A meal consumed through the feeding program was marked in the recall survey data. Interviews were conducted in the presence of the child's mother. If the interview day fell on a school day, both mother and child were interviewed either during the school lunch break or after school at the child's home. The activity recall survey recorded the hours spent by the child on household chores, farm and non-farm activities, including work for wages, on the previous day. Detailed data on household income and assets, monthly food consumption and expenditure and access to public utilities were also collected.

Since non-enrolled children can have significantly different observable and non-observable characteristics from enrolled children, in order to control for possible selection bias, children from the randomly sampled household were linked to schools they were enrolled in rather than linking a school based sample to households. Thus, within each village all the public and private primary schools were surveyed including any primary school outside the village boundary in which a significant number of village children were enrolled. Data were gathered on the nature of the feeding program (content and approximate quantity of each ingredient) at the school level and used to cross check the individual response in the household food consumption recall survey. A third questionnaire on the socio-economic characteristics of the village and expenditure on the feeding program was administered to the GPs. A total of 615 households, 74 primary schools (both public and private) and 41 villages were surveyed. A sub sample of 12 villages was revisited to collect the dietary recall data of the same child on a school and non-school day. These were the villages for which a non-school day either followed or preceded a school day and which were currently serving meals in the public primary schools.

---

[12] For the systematic random sampling of 15 households in a village, information was gathered on the total number of households residing in that village and then an interval was calculated for sampling. For instance, if in a village there were 120 households, every 8th household in the village was sampled. See Figure A1 in the Appendix for a schematic explanation of the sampling methodology employed in the survey of a typical village.

[13] The consumption survey was designed under the guidance of professional nutritionists at the University of Delhi who also trained the field workers in conducting the survey. See Table A6 in the Appendix for the design and details of the 24 hour consumption recall survey.

From the total sample of 615 households, 1096 children's dietary data are available. The summary statistics for this sample are presented in Table 1. The average age of the sampled children is 8.5 years, 51% of whom were boys. 89% of the children were currently enrolled in a primary school. Of the enrolled children, the average current grade is approximately 3[14]. Literacy rate of mothers is extremely low at merely 17% while 50% of fathers are literate. More than half the population is scheduled tribe and almost all households are male headed[15]. The annual household income from all sources is approximately Rs. 22,000[16]. The population is on an average poor, with more than 50% of the households included in the district administration's list of below poverty line households[17].

In Figure 1, the entire sample of 1096 children whose daily consumption data are available, are classified in terms of their current enrollment, whether their reference day was a school or non-school day, school attendance and intake of the cooked school meal on the reference day. Of the 976 children currently enrolled in school, for 781 children the reference day was a school day while for the remaining the dietary recall was for a non-school day. 660 of these 781 children attended school on the reference day. 607 of these 660 children were studying in public primary schools which were mandated to provide mid-day meals (MDM). However, only 467 of these children were offered a school meal on the reference day. The uptake of the program was nearly universal since only 19 children did not consume the school meal offered to them. I define individual participation in the program as school attendance and consumption of a school meal on the reference day.

Tables 2 and 3 present the mean individual and household characteristics of the sample by whether the reference day was a school or non-school day. Table 2 shows that the two sample groups are comparable in their observable characteristics except that there are a higher proportion of children belonging to a tribal and below poverty line household on a school day. However, any difference between the samples in these two characteristics is only likely to bias the effect of the program downwards. In Table 3, the mean daily hours of work performed by both sample groups is low and comparable across different types of activities, reinforcing my argument that these two days are not systematically different in terms of nutrient requirement. Work for wages by children was almost absent in the survey area.

Though the primary emphasis of the school meal program is on reducing the protein-energy deficiency of children, diet survey data indicates that besides these two nutrients, , iron, calcium and

---

[14] The grade of children enrolled in kindergarten has been coded as zero.
[15] The Constitution of India lists certain socio-economically backward groups in the population in a schedule. The tribal groups listed in this schedule are referred to as 'scheduled' tribes.
[16] Annual income includes value of agricultural output (either for sale or self consumption), wage income, salary income, self employment income, cash or in kind transfers, income from sale of forest produce and income from sale of or rent from other fixed and mobile assets.
[17] The state government carries out an official household survey to classify households as above or below poverty line. Below poverty line households are given a ration card for purchasing food grains at subsidized prices from government outlets.

riboflavin deficiency in children is also among the highest in India (Gopalan, Sastri and Balasubramaniam, 2004). In the empirical analysis, therefore, I study the impact of the meal program on five nutrients – energy or calories, carbohydrates, proteins, calcium and iron. Table 4 shows the consumption of each of these nutrients by children who ate a school meal on the reference day. The meal program provides a significant proportion of the daily intake of these five nutrients. For instance, school meals provided 263 kcal of daily calorie intake which constitutes more than 19% of the total daily calorie intake of the participants on the reference day.

Table 5 describes the household, school and village characteristics by the type of meal program offered in school in the last seven days prior to the survey interview for all children enrolled in a public primary school. Of the total number of children enrolled in public primary school, 51% were being served wheat porridge under the old scheme, 30% of the children's school was offering the new meal program, 8% were getting a monthly ration of raw food grains and 11% had not been served meals in the previous week nor were they receiving dry rations. The total daily calorie intake of children enrolled in a school offering the new meal program is the highest at 1416.14 kcals. The four groups are comparable in terms of gender composition and age. But arable land ownership of households with a recipient of school meals is lower compared to the first two groups and the children currently participating in the cooked meal program are more likely to belong to a below poverty line household compared to 36% of the children with 'no program'.

Looking at the school characteristics by type of meal program, it is interesting to note that the children who were currently not being provided with either cooked meals or raw food grains had been served school meals during four months since the beginning of the academic year in July. They had also been served cooked meals for at least half of the previous school month. But these schools were more irregular in providing meals than the currently participating schools in the program as shown by the summary statistics for 'regularity of meals served in previous week'. Based on my survey experience, the reasons for irregularity of the scheme could be as diverse as the cook being on a holiday, grain stocks having run out for the month or the grains having not been milled due to electric outage. On an average, villages which were currently providing cooked meals had a larger population and were more likely to have an older and tribal GP president. The GP presidents in the latter two groups were in office for a longer period.

On the whole, the children enrolled in schools offering the old and new meal scheme do not seem to differ systematically in their observable characteristics. However, it may be erroneous to draw conclusions about the observable characteristics of the non-participating households, schools or villages in the first two groups because of their small sample size.

Figure 2 shows the distribution of the entire sample in terms of the average total daily calorie intake of participants and non-participants in the cooked meal program on the reference day. Non-participation in the program may have arisen either due to non-enrollment, non-attendance, non-provision of a school meal or non-intake of a school meal on the reference day. The figure suggests that the distribution of total daily intake of the two groups is similar but program participants have a higher daily intake. Figure 3 compares the daily calorie intake of children who participated in the new cooked meal program on the reference day and those who participated in the old meal scheme. The distribution function shows that participants in the new school meal program have higher calorie intake compared to the children being provided with wheat porridge at school. Though these conclusions may be premature because of possible unobservable differences between participants and non-participants, they are indicative of the likely impact of the scheme on nutritive intakes.

However, a concern regarding the validity of any empirical result is that it may be attributable to measurement error in the calculation of nutrient intake if biases in the recall survey are systematically related to program participation. In the nutrition literature misreporting of food intake is well documented. Under reporting of food consumption in 24 hour recall surveys is a common problem and is related to obesity (Johansson et al., 2001). But there is a paucity of evidence on the existence or the direction of recall bias in developing countries. Harrison et al's (2000) study on food intake reporting by Egyptian women does not find any evidence of under reporting. Johansson et al. (2001) find no correlation between age, education and gender in biases in consumption recall data. Based on my fieldwork experience and the evidence in the literature, I find no reason to suspect a correlation between misreporting of food consumption and program participation status.

3.2 *Empirical Strategy*

In an ideal experiment in which children are randomly assigned to schools which are serving meals and those which are not and there is universal and uniform take up of the school meals by those assigned to participating schools, the coefficient on the dummy for consuming a school meal would be an unbiased and consistent estimate of the impact of program participation on daily nutrient intake. However, unobservable child or community characteristics might influence program participation as well as daily nutrient consumption. For instance, children who are ill are less likely to attend school and participate in the program and therefore more likely to consume lower (or zero) school meals as well as total nutrients. In this case, the program impact would be biased upwards.

I propose to address the potential endogeneity of program participation at the individual and community level through the following estimation strategies:

a. Cross sectional analysis: Assuming that community participation in the meal program is randomly distributed on a particular day, I estimate the impact of the program by comparing the total nutrient intake of attendees and non-attendees across all communities[18].

(6) $$C_{ijs}^{T} = \delta_0 + \delta_1 D_{js}^{A} + \delta_2 D_{js}^{A} * C_{ijs}^{M} + \delta_3' \mathrm{X}_j + \delta_4' X_j^{h} + \delta_5' X_j^{c} + \mu_{ijs}$$

C_{ijs}^{T} is the total consumption of nutrient *i* by child *j* enrolled in school *s* on the reference day, D_{js}^{A} is a dummy for school attendance on the reference day, C_{ijs}^{M} is the amount of nutrient *i* consumed from a school meal by child *j* on the reference day. X_j is a vector of individual characteristics of the child such as age and sex. X_j^{h} is a vector of household characteristics which includes, among other variables, household demographics, total annual household income, mother's literacy status and the total amount of transfer to siblings through the school meal scheme to control for the income effect of the program. Agricultural land ownership is included as a measure of wealth or permanent income of the household. Households are also classified as below or above the poverty line by including a dummy variable for the type of ration card provided to them by the GP to purchase food grains from the government ration shops. In addition, the proportion of tribal population of the village, distance of the village from all weather roads and the gender of the GP president are included as community variables in X_j^{c} which might influence the outcome of interest[19]. In Equation 6, δ_1 is an estimate of effect of school attendance on daily nutrient intake while δ_2 is the effect of attending and participating in the school meal program. Thus, δ_2 measures the differential impact of a 1 unit nutrient transfer through school meal on total daily nutrient intake between children who consume a school meal on the reference day and those who don't.

Since school attendance may not be an exogenous decision, particularly if the meal program itself impacts attendance rates, I use the randomness in whether the reference day was a school or non-school day to instrument for school attendance. Most of the non-school days were due to a Sunday or a public holiday. Whether or not the school opened on the reference day should be an exogenous determinant of the child's decision to attend. However, daily food consumption requirement should not vary systematically between school and non-school days for it to be a valid

[18] In the empirical analysis the sample is restricted to the currently enrolled. Since the sample of children is household rather than school based, 11% of children in the sample are currently not enrolled in a school. Among the several likely causes for non enrollment in developing countries, the demand for child labor (wage and non-wage) could be the primary reason for being out of school. These out of school children would have consumed zero school meal nutrients and if due to some unobservable characteristics they also have lower nutrient intake at home, then the program effect would be biased upwards. But child labor is negligible in the survey region. Using data gathered on economic activity in last 12 months of non-enrolled children in the survey, I find that less than 2% of them worked on the family farm the year round. Work for wages is almost absent for both farm and non-farm activity. The most likely reason for non-enrollment is delay since 66% of the non-enrolled are between ages 5-6 while the official age for entering grade 1 in primary school in India is 6 years.

[19] The gender of GP president may affect provision of local public goods (Chattopadhyay and Duflo, 2003), ST population in the village is an indicator of relative poverty and malnourishment of the population, distance from all-weather road is an indicator of access to health services and the reach of the district administration in ensuring and monitoring the implementation of public programs.

instrument. As discussed earlier, total nutrient requirement on school and non-school days is unlikely to be systematically different from each other.

Though all attending students across schools were offered a uniform quantity of cooked meal based on the official program guideline irrespective of grade, age or gender, it is possible that unobservable individual characteristics determined the *actual* intake of nutrients from school meals. For instance, hungrier students may ask and get additional helpings or students who don't like the taste of the meal may eat smaller quantities of the meal and throw the rest away. Thus, individual tastes or preferences might simultaneously affect the quantity of nutrients consumed from the school meal and total daily intake[20]. But the average nutrient consumption in a school from the school meal would be a good determinant of the actual nutrient intake by an individual student. I, therefore, use this measure as an instrument for individual school meal consumption which will also reduce any potential measurement biases in the nutrient transfer data. Another valid instrument for actual nutrient intake is the policy change which introduced the new meal program in February, 2004. which also addresses the potential endogeneity of program quality at the community level. Children whose interview date fell in February were more likely to have consumed higher nutrients from a school meal compared to children interviewed in January. Using the month of interview as an instrument I can check for the robustness of δ_2 further.

b. *Community fixed effects*: If the implementation of the program across the communities is not random as presumed in our previous model, then δ_2 would be biased and inconsistent[21]. Since the implementing agency is the GP and the characteristics of villages within a GP are likely to be homogenous, differencing the total nutrient intake of attendees and non-attendees within a GP would

---

[20] In the empirical model I assume universal take-up of the program which is held up by the data. Only 4% of the school children who were offered a meal at school refused to eat it, a negligible proportion of the sample. This is expected considering the fact that the sampled region is and nutritionally deprived and the majority of the school children came from families on or below the poverty line.

[21] Self-selection by survey households into the school meal program through physical relocation is not of concern in the analysis. 96.9% of the sample is enrolled in a public primary school within their residing village. Since subsistence farming is the primary occupation and arable agricultural land is a fixed and immovable asset children mostly enroll in primary schools closest to their hamlet. Even if parental mobility is more restricted because they are tied to their land if the children relocate (for instance, reside with relatives in another village) on the basis of expectations of which school would provide school meals then it would show up in the survey data on the number of months each member resided with the household in the last 12 months. However, 97.8% of all children currently enrolled in a public primary school had resided with the same household for all of the previous 12 months. In the survey, parents were asked also asked how much they expect the total expenditure in the current academic year to be on schooling for each student in the household. One of the categories of expenditure was 'Other (including transportation costs)'. 99% of the respondents expected zero 'Other' costs for children enrolled in a public primary school. These survey findings are supported by district level migration data from the 1991 census. According to the census, of the total rural population of the survey district, 70.4% of the population was born at the place of enumeration. Of the total number of migrants in rural areas of the district, less than 1% had resided for a year or less at the place of enumeration. Most of this short duration migration is for employment reasons and seasonal in nature. At the all India level, merely 5% of males and less than 1% of females cited education as the reason for migration. This figure is likely to be even more negligible for rural India.

remove any unobservable community characteristics which influence the nature of the school meal scheme as well as the total nutrient consumption of the respondents.

c. *Individual Fixed Effects*: The robustness of the results obtained from the cross sectional and community fixed effects model is checked by using the individual panel data. Survey data were obtained on the 24 hour recall of food consumption for the same child on both school and non-school day in a sub sample of 12 villages whose public primary schools had offered school meals on the last school day.

(7) $$C_{ij}^{T} = \delta_0 + \delta_1 D_j^{A} + \delta_2 C_{ij}^{M} + \delta_3 \sum_{s=1}^{n} C_{ijs}^{h} + D_j + \mu_{ij}$$

In Equation 4, $\sum_{s=1}^{n} C_{ijs}^{h}$ is the sum of the nutrient *i* consumed from the school meal by all 5-12 year old siblings *s* of child *j*. δ_2 is the impact of child's nutrient intake on a day she attended school and participated in the feeding program compared to the nutrient intake on a non-school day. This estimator gives the impact of the program by differencing fixed, unobservable individual characteristics that could be correlated with program participation status as well as total daily intake.

4 Results

4.1 Impact of the School Feeding Program on Total Daily Nutrient Intake

I begin by analyzing a baseline OLS model which regresses a dummy for consumption of a school meal on the reference day on total daily intake of calories, carbohydrates, proteins, calcium and iron. Each row in Table 6 shows the coefficient of school meal intake dummy for four separate regression models for each of the five nutrients. In column 1, the sample includes all children for whom consumption data are available, including the non-enrolled, with only age and gender as control variables. The coefficient for the school meal consumption dummy is positive and significant for all nutrients except calcium. For instance, the coefficient on consumption of school meal for daily calorie intake as the dependent variable implies that consuming a school meal increases total daily intake of calories by more than 78 kcals. In column 2, I augment the model by including the child's household and community characteristics as additional controls. The magnitude or significance of the coefficient of participation in the meal scheme is not affected much if we compare the coefficients in columns 1 and 2 for all the nutrients. In specifications 3 and 4, children enrolled in private schools and the non-enrolled are dropped from the sample since private schools are not mandated to provide cooked meals. The coefficient of the dummy for program participation is larger in magnitude in both column 3 and 4 compared to the estimates obtained from the inclusion of the entire sample in columns 1 and

2, except for iron. These results allow us to form certain expectations of the probable magnitude of program impact even though they do not account for the selection issues.

Next, I quantify the magnitude of the program transfer and address some of the potential endogeneity concerns. Table 7 describes the results of the 2 SLS cross sectional estimation strategy for calorie intake enunciated in the previous section. The first stage regression results for school attendance, calorie intake from the program and the total quantity of calories consumed by all siblings in the primary school age-group are shown in columns 1, 2 and 3 respectively[22]. The second stage regression results are presented in column 4. The coefficient on all three instruments exhibit high t-statistic and the F-statistic for all the three first stage regressions are large indicating good predictive power of the instruments[23]. Most of the coefficients are of expected sign in the second stage regression. Older children have a higher daily calorie intake as shown by the positive coefficient on child's age in column 4. The positive coefficient on the log of household income indicates that the calorie consumption of children in richer households is larger. But, surprisingly, having a literate mother has a negative effect on a child's calorie intake. This might suggest that a mother with higher expected returns in the labor market is unable to spend enough time in child care.

I compare the magnitude and direction of the coefficient on the transfer for all five nutrients across specifications in Table 8. The assumption of exogeneity of school nutrient intake, attendance and program implementation is relaxed progressively in the corresponding rows. The sample is restricted to children enrolled in public primary schools. Specifications 1-4 compare the impact of the meal program between attendees and non-attendees across program implementing and non-implementing communities. Specification 1 presumes that both school nutrient intake and attendance are exogenously determined. In row 1 column 1, the estimate indicates that a 1 kcal transfer from the school meal program raises the daily calorie intake by 0.57 kcal. For carbohydrates, proteins and calcium, too, the point estimates of the impact of the program transfer are similar as shown in the first row. However, the coefficient for iron transfer is larger suggesting that 85% of it sticks to the child. In specification 2, the exogeneity assumption of school nutrient intake is relaxed by using the average nutrient consumption in school interacted with a dummy for school attendance on the reference day as an instrument. The coefficients are close to those obtained from specification 1 for all the nutrients.

Specification 3 corresponds to the 2SLS analysis for calories described in Table 7. It treats both actual school nutrient intake and attendance as endogenous. The randomness in whether the reference day was a school or a non-school day is used to instrument for school attendance. The

[22] Total calorie consumed by 5-12 year old siblings is instrumented by the mean of the average calorie consumed in their schools (0 if all non-enrolled)* number of siblings* dummy for school day.

[23] The magnitude and the sign of the coefficients are approximately similar for all nutrients. The F-statistics for the first stage regressions for the other 4 nutrients are comparable in magnitude to the analysis for calories in all the empirical models described in section 3.2. See Table A1 and A2 in Appendix for a detailed description of the results of the other 2SLS models.

coefficient for all the nutrients continues to suggest that the child's daily intake rises by approximately half of the transfer except for iron which is significantly larger. As a robustness check I use the policy change in February, 2004 which introduced the 'new' meal scheme across communities as another source of exogenous variation in the quality and quantity of the transfers through the meal program in specification 4. Using the month of interview as an instrument for individual school nutrient intake, I find that children who were interviewed in the second month of the survey and had participated in the program on the reference day have higher daily intake of calories, carbohydrates, proteins and iron compared to non-participants or children who participated in the old meal scheme in the previous month. This is indicated by the positive and significant coefficients on intake of these nutrients from a school meal in row 4. However, the standard errors for this model are higher relative to models 1-3 and the coefficient for calcium intake is insignificant. This may be because the proportion of calcium in the new meal program was not significantly higher than in the old meal scheme unlike calories, carbohydrates, iron and proteins.

I relax the assumption that community participation in the program was exogenous by analyzing the impact of the program in a community fixed effects model in specifications 5 and 6. However, the date of interview does not vary within a village since all children of a particular village were interviewed on the same day nor is there significant variation in average school nutrients across schools within a village. Hence, I am unable to instrument for attendance and actual meal intake without losing identification in a within village analysis. Nevertheless, I compare enrolled attendees and non-attendees in villages whose school functioned on the reference day in specification 5 using a village fixed effects model. The coefficient for the impact of the transfer of nutrients through the school feeding program on daily intake is comparable to the results from the cross sectional analysis in specification 4.

In specification 6, I restrict the data to a random sample of five GPs with a total of eleven villages within their purview. For each of these GPs, data are available for at least two villages administered by it. Within each GP there is random variation in the date of village survey. Villages within a GP are likely to be homogeneous in terms of any unobservable characteristics that might simultaneously affect program implementation and the outcome of interest[24]. I instrument for nutrient intake and attendance using the variation in the average nutrients consumed in a school and the reference day being a school or non-school day. The estimates of the coefficients for calorie and carbohydrates are larger than obtained from the within community analysis in specification 5 for calories and carbohydrates. But the coefficients for proteins and iron consumption are no longer significant.

[24] In the GP survey information was gathered on when the cooked school meal scheme was implemented in all the villages within that GP. In all except one of the 36 GPs cooked meals were initiated in all public primary schools, within its purview, in the same month.

Finally, accounting for unobservable individual characteristics which might influence both the coefficient of interest and the dependent variable, I report the results from the analysis of the consumption recall data on a school and a non-school day for the same child in specification 7 to check the robustness of the estimates from the cross sectional and community fixed effects analysis. This is a random sample restricted to children whose schools were offering cooked meals on school days. I difference the total nutrient intake of a child who participated in the meal program on a school day with her intake on non-school day. The treated children are compared to a control group who did not eat a school meal on either day. These children were either enrolled in private primary schools or middle schools or did not attend their public primary school on both days. Consuming 100 kcal from the school meal program raises total daily intake by 76 kcal. This estimate is very close to that obtained from the within GP analysis in specification 6. However, the coefficient is not significant for the other nutrients. It is important to note that the coefficient of school nutrient intake for each nutrient is not strictly comparable across the different models since the sample and the methodology varies across them. It may be that the smaller sample sizes in successive specifications reduce the variation in the sample, affecting the significance of the coefficient of intake of nutrients other than calories from the school meals.

The preferred estimates from the community and individual fixed effects models indicate that the total daily calorie consumption of the child increases by the full amount of the transfer since the coefficients for calorie transfer are not significantly different from 1 in models 5-7[25]. However, the results for the other four nutrients are not robust to changes in specification.

4.2 Impact of the School Feeding Program on Nutrient Substitution Between Meals

There are two mutually exclusive concerns which may cause disquiet about the reliability of the estimates described in the last section. The first and less likely worry is that the coefficient on the program effect will be biased upwards if parents are withdrawing nutrients away from the recipient of the transfer on non school days. But as elucidated earlier, a school week consist of six days in the survey region. Parents would be behaving inefficiently if they were not withdrawing nutrients on these six days but only on the non-school day from the child. The second and more likely scenario is that parents withdraw nutrients from the child on days she receives the transfer and then compensate her on non school days when there is no meal program, biasing the program effect downwards. This would imply that parents substitute nutrients away from the child between meals on school days.

I attempt to address both these concerns with the estimation strategy by disaggregating the total daily nutrient consumption of the child into intake during school and non-school time to analyze

[25] See Table A3 in the Appendix on P values of F-tests for the coefficient on the nutrient intake from the school meal being statistically equivalent to 1.

the effect of consuming nutrients from a school meal on nutrient intake during these meals[26]. If the parents are indeed reducing the nutrient intake of the child, say after school, then it is possible that some of these nutrients are reallocated to the child on a non school day.

The results on the effect of the transfer through the school feeding program on nutrient intake during school time are shown in Table 9[27]. The significant negative coefficient on school attendance for almost all nutrients in all the three models suggests that children who attend school consume fewer nutrients on average during school time than those who don't attend school. However, children who participate in the meal program have higher nutrient intake as shown by the positive coefficient on quantity of nutrients consumed from the school meal scheme. The coefficient on school meal is statistically significantly different from 1 in the cross sectional model while both the community and individual fixed effects models suggest a one-for-one increase in nutrient intake of program participants except for iron. Since the latter two models are the more reliable estimates, I conclude that there is no reallocation of calories by the families during school time by withdrawing nutrients from home meals. But they could be withdrawing food at other meal time: before or after school.

Thus, I next estimate the impact of consuming a meal at school on total nutrient intake after school described in Table 10[28]. The positive, though mostly insignificant, coefficient on school attendance suggests that children who attend school eat more after getting back from school compared to non-attendees. But the point estimates on the school meal transfer are small and insignificantly negative in all specifications except for iron in model 6.

The findings show that parents are not withdrawing nutrients during meals at non-school hours as well as school hours, as indicated by the community and fixed effects estimates. Also, there are no significant differences in nutrient intake during meals after and before school time between school and non school days suggested by the insignificant coefficient on attendance in Table 10. However, a priori, if children who attend school consume less during school time on average, implied by the negative coefficient on attendance in Table 9, then our estimated program effect may be biased downwards.

4.3 Determinants of Intra-household Resource Reallocation

[26] Nutrient consumption during school time is the sum of the nutrient consumption at home plus nutrients consumed through a school meal during school hours. The survey gathered information on the school timings for each child in the household survey (usually 10 a.m. to 4 p.m. for primary schools). Since the public primary schools were located within the village premises children could possibly walk home during the lunch break for a meal (Refer to map of typical village in Figure A1 in Appendix).

[27] The results in Tables 9 and 10 are not strictly comparable with those in Table 8. In Table 8 children enrolled in public secondary schools are included in the sample. These children are excluded from the analysis in Tables 9 and 10 because public secondary schools are usually outside the village premises and typically these children are unable to eat at home during school lunch break unlike public primary school children. Since secondary schools are not mandated to serve school meals, inclusion of these children in the analysis may bias the program effect on total nutrient intake during school upwards and after school intake downwards.

[28] Results are similar for nutrient intake before and after school. See Table A4 in Appendix for results of analysis on total nutrient intake before school.

The intra-household resource allocation literature suggests that individual or family characteristics may be important determinants of how the household distributes its income among its members. In order to assess whether these characteristics have any influence on the magnitude of the government transfer program that sticks to the child, I interact the coefficient of quantity of calorie intake from the school meal program with child sex, age, household size, quantity of transfer to siblings and annual household income. The results of this analysis are shown in Table 11. The model corresponds to specification 3 in Table 8. In columns 1 and 3 the estimates are reported for separate regressions for each interaction term while in columns 2 and 4 all the interaction terms are included in a single regression for total daily calorie intake and total calorie intake during school time as the dependent variables.

I find no significant effect of gender, age or annual household income on the magnitude of the calorie transfer that sticks to the child in both columns 1 and 2 as suggested by the insignificant coefficients on the interaction of a boy, the age and the household income with the amount of calories transferred through the program. However, the coefficient of the interaction of family size with the calorie transfer through the feeding program is positive and significant in column 1 but not when all the interaction terms are included in a single regression in column 2. In column 3 the analysis for calorie intake during school time, however, suggests that more of the transfer sticks to younger children and an increase in the total transfer to siblings in the primary school age group the lower is the redistribution away from the individual child. These coefficients are robust in a single regression as well in the last column. The positive coefficient on household income and the negative coefficient on household size in column 4 indicate that poorer and larger households are more likely to tax a transfer recipient.

5 Conclusion

The unitary household model predicts that benefits to an individual household member from a public transfer to the family as a whole are equivalent to a targeted transfer to that member if household resources are perfect substitutes for resources provided through the program. A pertinent question, therefore, arises as to whether such public programs are efficient in targeting individual beneficiaries. Using the supplementary school feeding program in India, I test this hypothesis to find that public transfers intended to benefit individuals almost entirely stick to them. Using a series of empirical methodologies which approach the ideal of randomized program assignment, I find that the daily nutrient intake of program participants increases by between 49% and 100%, indicating that for most of the nutrients the transfer does not stick to the child one-for-one. But the point estimates are not statistically significantly different from 1, particularly when I account for endogenous program participation through a community and individual fixed effects models. However, I find evidence of heterogeneity in households' response to the program. The daily nutrient intake of younger children increases by a larger proportion of the transfer compared to older children in the primary school going age group. Resource redistribution is less in response to the public transfer program for children belonging to smaller and to economically better off families. Also, the nutrient transfer is more likely to stick to the child if her siblings too are recipients of school meals.

These results are in keeping with those from the assessment of the school meal scheme in Philippines by Jacoby (2002) for daily calorie consumption. I find that the stickiness of the transfer is comparable across nutrients other than calories though there is some variation in the magnitude of the point estimates.

The results of this paper have significant implications for the efficacy of targeted welfare programs, in general, and supplementary feeding programs, in particular, in developing countries. In the case of the program evaluated here the benefits to the individual recipient are quite substantial. The findings of this paper imply that the gap between the average Recommended Dietary Allowance (RDA) and the actual daily intake of the children in the primary school going age group in the survey region is reduced by upto 35% for calorie intake, the daily iron deficiency by 25% and meets almost the entire daily protein deficiency of the child. Thus, the program is able to achieve a substantial reduction in hunger at school at very low cost per child per day- 1.33 cents for the wheat porridge scheme to 2.97 cents for the 'improved' wheat bread and vegetables or lentils program, per child per day. Though the cost of this on site cooked meal program might be higher than the cost of a pre-cooked take home meal or distributing raw food to the child (Beaton and Ghassemi, 1982), the results here suggest that the loss in benefit to the child from a transfer to the household as a whole relative to a scheme targeted at the child might be much greater than the reduction in cost.

Future work calls for detailed data on the food consumption as well as consumption of other non-subsidized goods by both program participants and non participants within the household in order to estimate the magnitude of resource redistribution and externalities, if any, generated by such targeted transfer programs. Panel data on nutrient intake and long term health indicators such as height for age of participants and non-participants would also be helpful in determining whether the impact of supplementary feeding programs are permanent or transitory.

References

Akin, John S., David K. Guilkey and Barry M. Popkin.1983. "The School Lunch Program and Nutrient Intake: A Switching Regression Analysis," *American Journal of Agricultural Economics*, 65(3): 477-485.

Allen, Lindsay H. and Stuart R. Gillespie. 2001. "What Works? A Review of the Efficacy and Effectiveness of Nutrition Interventions," Manila: U.N. Administrative Committee on Coordination Subcommittee on Nutrition, in collaboration with Asian Development Bank.

Altonji, J., Fumio Hayashi and L. Kotlikoff. 1997. "Parental Altruism and Inter Vivos Transfers: Theory and Evidence," *Journal of Political Economy*, 105(6): 1121-1166.

Aromolaran, Adebayo B. 2004. "Intrahousehold Redistribution of Income and Calorie Consumption in South-Western Nigeria," Economic Growth Center Discussion Paper # 890, Yale University.

Beaton, G. and H. Ghassemi.1982. "Supplementary Feeding program for Young Children in Developing Countries," *American Journal of Clinical Nutrition*, 35(4): 864-916.

Becker, Gary. 1974. "A Theory of Social Interactions," *Journal of Political Economy*, 82(6): 1063-1093.

Behrman, Jere R. 1988. "Nutrition, Health, Birth Order and Seasonality: Intra-household Allocation Among Children in Rural India," *Journal of Development Economics*, 28(1): 43-62.

Behrman, Jere R. 1996. "The Impact of Health and Nutrition on Education," *World Bank Research Observer*, 11(1): 23-37.

Behrman, Jere R and Anil Deolalikar. 1989. "Seasonal Demands for Nutrient Intakes and Health Status in Rural South India," in Causes and Implications of Seasonal Variability in Household Food Security, ed. D. Sahn, Washington, Johns Hopkins.

Behrman, Jere R and John Hoddinott. 2005. "Program Evaluation with Unobserved Heterogeneity and Selective Implementation: The Mexican *PROGRESA* Impact on Child Nutrition," *Oxford Bulletin of Economics and Statistics*, 67(4): 547-569.

Chattopadhyay, Raghabendra and Esther Duflo.2003. "Women and Policy Makers: Evidence from A Randomized Policy Experiment in India," *Econometrica*, 72(5): 1409-1443.

Cox, Donald and George Jakubsen. 1995. "The Connection Between Public Transfers and Private Interfamily Transfers," *Journal of Public Economics*, 57(1): 129-167.

Das Gupta, Monica, Michael Lokshin and Oleksiy Ivaschenko. 2004. "Integrated Child Development Services Nutrition Program: Who Does it Reach and What Effects Does it Have?" Paper presented at the Population Association of America Meeting, March 31-April 2, 2004, Philadelphia.

Devaney, Barbara and Thomas Fraker.1989. "The Dietary Impact of the School Breakfast Program," *American Journal of Agricultural Economics*, 71(4): 932-948.

Dreze, Jean and Geeta Gandhi Kingdon. 2000. "School Participation in Rural India," *Review of Development Economics*, 5(1): 1-33.

Duflo, Esther. 2003. "Grandmother and Granddaughters: Old Age Pension and Intra-Household Allocation in South Africa," *World Bank Economic Review*, 17(1): 1-25.

Gleason, Philip M. and Carol Suitor. 2003. "Eating at School: How the National School Lunch program Affects Children's Diets," *American Journal of Agricultural Economics*, 85(4): 1047-1061.

Gopalan, C., B.V. Rama Shastri and S.C. Balasubramanian. 2004. "Nutritive Value of Indian Foods," National Institute of Nutrition, Indian Council of Medical Research.

Government of India. 1995. "Nutrition Support to Education," *Report of the Committee on Mid Day Meals.*

Harrison, Gail, Osman M. Galal, Nabih Ibrahim, Ahmed Khorshid, Ame Stormer, Joanne Leslie and Nadia T. Saleh. 2000. "Under Reporting of Food Intake by Dietary Recall Is Not Universal: A Comparison of Data from Egyptian and American Women," *Journal of Nutrition*, 130(8): 2049-2054.

Jacoby, Hanan G. 2002. "Is There an Intrahousehold Flypaper Effect? Evidence from a School Feeding Program," *Economic Journal*, 112 (476): 196-221.

Jacoby, Enrique, Santiago Cueto and Ernesto Pollitt. 1996. "Benefits of a School Breakfast Program Among Andean Children in Huaraz, Peru," *Food and Nutrition Bulletin*, 17(1): 54-64.

Jensen, Robert T. 2003. "Do Private Transfers Displace the Benefits of Public Transfers? Evidence from South Africa," *Journal of Public Economics*, 88(1): 89-112.

Johansson, Gunnar, Asa Wikman, Ann-Mari Ahren, Goran Hallmans and Ingegerd Johansson. 2001. "Under Reporting of Energy Intake in Repeated 24 Hour Recalls Related to Gender, Age, Weight Status, Day of Interview, Educational Level, Reported Food Intake, Smoking Habits and Area of Living," *Public Health Nutrition*, 4(4): 919-927.

Kremer, Michael, Sylvie Moulin and Robert Namunyu. 2002. "Unbalanced Decentralization," mimeo, Harvard University.

Long, Sharon K. 1991. "Do the School Nutrition Programs Supplement Household Food Expenditures?" *Journal of Human Resources*, 26(4): 654-678.

Lundberg, Shelly J., Robert A. Pollak and Terence J. Wales. 1997. "Do Husband's and Wives Pool Their Resources? Evidence from the United Kingdom Child Benefit," *Journal of Human Resources,* 32(3): 463-480.

Martinelli, Cesar and Susan W. Parker. 2003. "Do School Subsidies Promote Human Capital Investment Among the Poor?" Discussion Paper 03-06, Centro De Investigacion Economica.

Martorell, Reynaldo. 1993. "Enhancing Human Potential in Guatemalan Adults through Improved Nutrition in Early Childhood," *Nutrition Today*, January-February: 6-13.

Pitt, Mark M., Mark Rosenzweig and Md. Nazmul Hassan. 1990. "Productivity, Health and Inequality in the Intrahousehold Distribution of Food in Low Income Countries," *American Economic Review*, 80(5): 1139-1156.

Ravallion and Wodon. 2000. "Does Child Labor Displace Schooling? Evidence on Behavioral Response to an Enrollment Subsidy," *Economic Journal*, 110 (462):158-175.

Rosenzweig, Mark and Paul Schultz. 1982. "Market Opportunities, Genetic Endowments and Intrafamily Resource Distribution: Child Survival in Rural India," *American Economic Review*, 72(4): 803-815.

Rosenzweig, Mark and Kenneth I. Wolpin. 1994. "Parental and Public Transfers to Young Women and Their Children," *American Economic Review*, 84(5): 1195-1212.

Schultz, T.P. 2004. "School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program," *Journal of Development Economics*, 74(1): 199-250.

Seshadari, Subadra and Tara Gopaldas. 1989. "Impact of Iron Supplementation on Cognitive Functions in Preschool and School-Aged Children: The Indian Experience," *American Journal of Clinical Nutrition*, 50(3): 675S-684S.

Soemantri, A. G. 1989. "Preliminary Findings on Iron Supplementation and Learning Achievement of Rural Indonesian Children," *American Journal of Clinical Nutrition*, 50(3): 698S-701S.

-------------2000. "Ending Malnutrition by 2020: An Agenda for Change in the Millennium, Final Report to the ACC/SCN by the Commission on Nutrition Challenges of the 21st Century," *Food and Nutrition Bulletin*, 21(3) Supplement.

-------------1998-99. National Family Health Survey, International Institute for Population Sciences, Mumbai.

Vermeersch, Christel and Michael Kremer. 2005. "School Meals, Educational Achievement and School Competition: Evidence from a Randomized Evaluation," Working Paper #3523, World Bank.

Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Male	1096	0.51	0.50	0	1
Age	1096	8.55	2.33	4	14
Currently enrolled	1096	0.89	0.31	0	1
Grade enrolled in	976	2.96	1.55	0	7
Total daily calorie intake on reference day (kcals)	1096	1312.45	450.77	197	3204.49
Mother literate	1062	0.17	0.38	0	1
Father literate	1042	0.50	0.50	0	1
Head of household literate	1096	0.46	0.50	0	1
Male head of household	1096	0.98	0.15	0	1
Head of household scheduled tribe	1096	0.54	0.49	0	1
Number of household members	1096	6.58	2.04	2	18
Number of 5-12 year old siblings residing in household	1096	1.15	0.87	0	4
0-4 year old male members	1096	0.42	0.65	0	5
0-4 year old female members	1096	0.37	0.61	0	3
5-14 year old male members	1096	1.20	0.87	0	5
5-14 year old female members	1096	1.31	1.06	0	5
15-60 year old male members	1096	1.48	0.79	0	6
15-60 year old female members	1096	1.58	0.78	0	5
60+ year old male members	1096	0.09	0.30	0	2
60+ year old female members	1096	0.12	0.33	0	2
Total annual household income (Rs.)	1096	21807.56	19207.00	2913	211777.7
Below poverty line	1096	0.50	0.50	0	1
Arable land ownership (acre)	1096	4.35	6.79	0	70

Figure 1: Sample Distribution

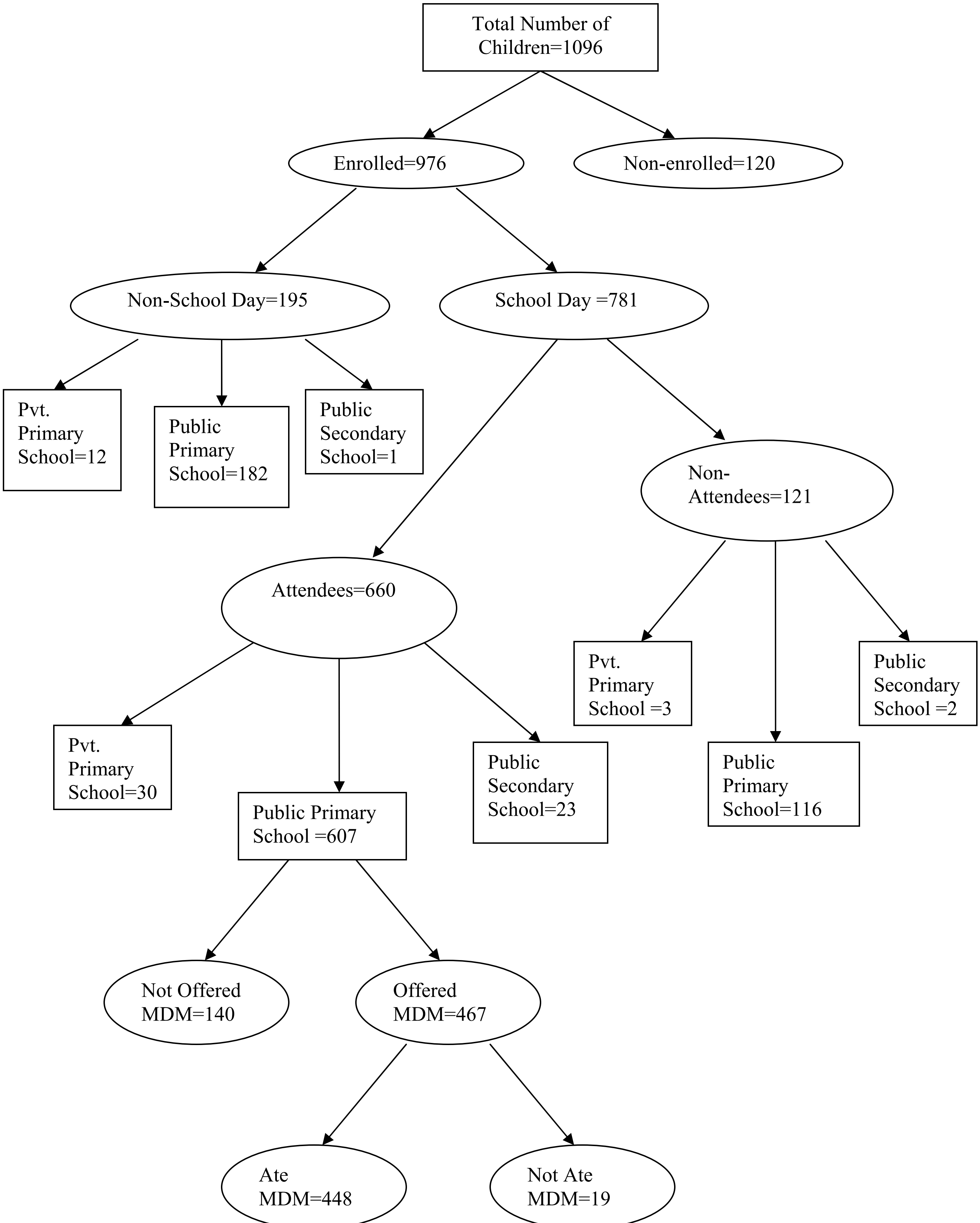

Table 2: Mean Characteristics by School and Non-School Day

Variable	Non-School Day (N=195)	School Day (N=781)
Male	0.50 (0.503)	0.53 (0.526)
Age	8.65 (0.172)	8.81 (0.078)
Grade enrolled in	2.77 (0.107)	3.00 (0.056)
Total daily calorie intake on reference day (kcal)	1330.81 (31.004)	1337.82 (16.010)
Mother literate	0.19 (0.028)	0.18 (0.014)
Father literate	0.48 (0.036)	0.51 (0.018)
Male head of household	0.98 (0.010)	0.97 (0.006)
Head of household scheduled tribe	0.39 (0.035)	0.55 (0.018)
Number of household members	6.86 (0.203)	6.48 (0.064)
Total annual household income (Rs.)	22203.96 (1116.524)	21770.24 (731.100)
Below poverty line	0.41 (0.035)	0.52 (0.018)
Arable land ownership (acre)	3.46 (0.370)	3.99 (0.212)

Note: Standard errors in parentheses

Table 3: Activity Recall Data for School and Non-School Day (hours per day)

Activity	Mean	Std. Dev.	Min.	Max.
School Day (N=781)				
cooking	0.15	0.41	0	3
household cleaning	0.30	0.47	0	4
sibling care	0.23	0.52	0	4
livestock care	0.35	0.86	0	8
collecting water and firewood	0.47	0.56	0	4
Non-School Day (N=195)				
cooking	0.18	0.48	0	3
household cleaning	0.28	0.46	0	3
sibling care	0.25	0.49	0	2
livestock care	0.46	0.99	0	5
water and firewood	0.46	0.87	0	10

Table 4: Nutrient Consumption of Program Participants on Reference Day

Nutrient (unit) (N=448)	Total Daily Consumption	Consumption from School Meal	Percentage of Total Daily Consumption from School Meal
Calories (kcals)	1379.80	263.06	19.07
	(440.99)	(128.22)	
Carbohydrates (g)	261.17	48.66	18.63
	(83.29)	(25.77)	
Protein (g)	42.45	8.27	19.48
	(14.35)	(4.60)	
Calcium (mg)	145.84	32.74	22.45
	(113.88)	(19.87)	
Iron (mg)	13.04	3.46	26.53
	(6.21)	(1.78)	

Note: Standard deviations in parentheses.

Table 5: Mean Characteristics by Type of Meal Program in Public Primary Schools in the Seven Days Prior to the Survey

Variable	No Program	Raw Food Grains	Old Meal Program	New Meal Program
Number of households	57	45	268	174
Number of children	95	75	457	275
Total daily calorie intake (kcals)	1272.73	1206.19	1317.05	1416.98
	(42.86)	(39.43)	(20.31)	(28.45)
Male child	0.52	0.53	0.48	0.56
	(0.05)	(0.06)	(0.02)	(0.03)
Age	8.48	8.79	8.69	8.99
	(0.22)	(0.23)	(0.10)	(0.14)
Mother literate	0.12	0.25	0.14	0.16
	(0.03)	(0.05)	(0.02)	(0.02)
Father literate	0.46	0.55	0.52	0.40
	(0.05)	(0.06)	(0.02)	(0.03)
Number of household members	7.32	6.30	6.57	6.33
	(0.34)	(0.16)	(0.08)	(0.12)
Male household head	1.00	0.99	0.97	0.98
	(0.00)	(0.01)	(0.01)	(0.01)
Age of head	41.93	41.01	38.36	41.18
	(1.28)	(1.10)	(0.42)	(0.65)
Scheduled tribe head of household	0.40	0.63	0.56	0.53
	(0.05)	(0.06)	(0.02)	(0.03)
Annual household income (Rs.)	20072.58	20929.12	19862.95	22792.04
	(1455.28)	(1905.18)	(687.33)	(1327.68)
Arable land ownership (acres)	4.39	4.65	3.62	3.67
	(0.74)	(0.85)	(0.23)	(0.31)
Below poverty line	0.36	0.47	0.53	0.50
	(0.05)	(0.06)	(0.02)	(0.03)
School Characteristics				
Number of schools	7	4	32	21
Number of months in which cooked meals served since July	4.14	0.79	5.05	5.52
	(0.25)	(0.10)	(0.06)	(0.08)
Proportion of school days in which meals served in previous month*	2.81	0.00	3.68	3.84
	(0.15)	(0.00)	(0.03)	(0.02)
Proportion of school days in which meals served in previous week	0.00	0.00	0.89	0.86
	(0.00)	(0.00)	(0.01)	(0.02)
Teacher student ratio	0.02	0.02	0.02	0.02
	(0.00)	(0.00)	(0.00)	(0.00)
Village characteristics				
Village population	689.78	518.45	758.76	999.00
	(19.45)	(20.59)	(16.55)	(27.19)
Percentage of tribal population (1991 census)	39.72	66.47	56.89	48.51
	(3.05)	(2.10)	(1.30)	(1.99)
Proportion of irrigated arable land	0.13	0.14	0.15	0.19
	(0.01)	(0.01)	(0.00)	(0.01)
Distance from all weather road (kms.)	4.86	6.27	5.04	5.51
	(0.31)	(0.61)	(0.19)	(0.30)
Age of GP president	35.07	38.23	42.81	44.66
	(0.45)	(0.72)	(0.39)	(0.49)
Male GP president	0.69	0.13	0.65	0.55
	(0.05)	(0.04)	(0.02)	(0.03)
Scheduled tribe GP president	0.68	0.24	0.70	0.73
	(0.05)	(0.05)	(0.02)	(0.03)
No. of years GP president in office	4.00	4.00	4.83	4.92
	(0.00)	(0.00)	(0.13)	(0.14)

Note: Standard errors in parentheses.
* Response coded as: (0) none of the school month (1) less than half of school month (2) half of school month (3) more than half of school month (4) all school month

Figure 2: Distribution of Total Daily Calorie Intake

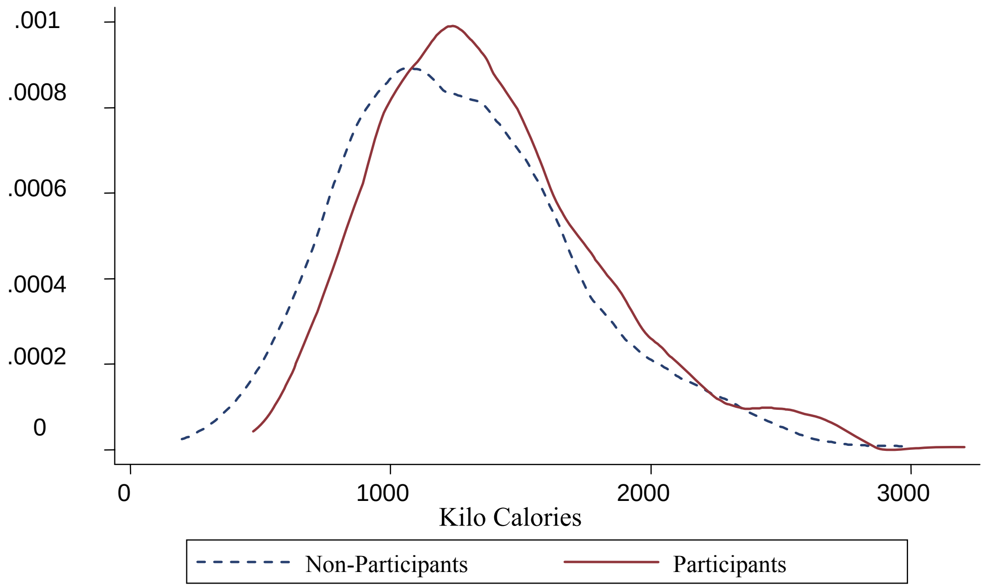

Figure 3: Distribution of Total Daily Calorie Intake by Type of Meal Program

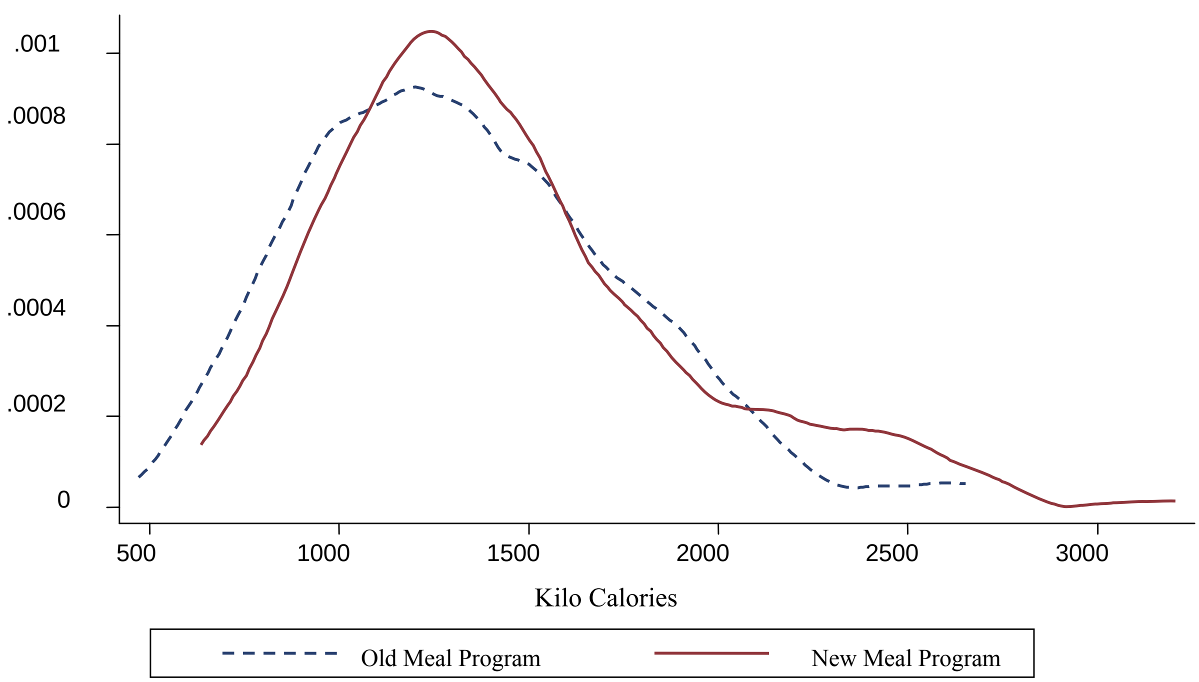

Table 6: Initial OLS Regressions for the Impact of School Meal Consumption on Total Individual Daily Nutrient Intake

Dependent Variable	**Coefficient of Dummy for Consuming School Meal**			
Total Daily Nutrient	*Specification*			
	(1)	**(2)**	**(3)**	**(4)**
Calories	78.65**	78.55**	83.07**	89.14**
	(32.488)	(32.697)	(34.840)	(34.857)
Carbohydrates	15.59**	15.79***	16.10**	17.50**
	(6.079)	(6.080)	(6.517)	(6.498)
Protein	2.78***	2.69**	2.88**	3.00**
	(1.050)	(1.067)	(1.127)	(1.141)
Calcium	9.11	10.30	10.78	10.43
	(9.670)	(10.107)	(10.649)	(11.156)
Iron	1.60***	1.60***	1.54**	1.66***
	(0.566)	(0.528)	(0.599)	(0.543)
N	1096	1062	931	901

Notes: Robust standard errors corrected for clustering on the household reported in parentheses.
(1) Sample includes all children for whom consumption data are available with only child's age and sex as control variables.
(2) Sample includes all children for whom consumption data are available with child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls.
(3) Sample includes children enrolled in public schools only with child's age and sex as control variables.
(4) Sample includes children enrolled in public schools only with child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls.
* Significant at 10%, ** 5% and ***1

Table 7: Impact of School Meal Calorie Intake on Total Individual Daily Calorie Intake (2SLS)

	First Stage	First Stage	First Stage	Second Stage
Control Variables\ Dependent Variable	School attendance	Calories from school meal	Total Calories consumed by siblings from school meal	Total Individual Daily Calories
School attendance†				-95.472
				(66.779)
Calories from school meal†				0.488
				(0.187)
Total calories consumed from school meal by 5-12 year old siblings residing in household†				0.041
				(0.169)
Child's Age	0.012	5.195	1.426	62.229
	(0.005)	(1.596)	(1.839)	(6.794)
Male child	0.010	10.264	1.682	11.235
	(0.028)	(8.563)	(9.862)	(32.261)
Number of 5-14 yr old males in household	0.012	-5.450	-10.376	-30.630
	(0.018)	(5.365)	(6.178)	(28.657)
Number of 5-14 yr old females in household	0.003	0.644	-11.125	-49.477
	(0.015)	(4.433)	(5.106)	(18.7050
Number of 0-4 yr old males in household	-0.015	-2.786	4.477	2.662
	(0.018)	(5.548)	(6.390)	(27.709)
Number of 0-4 yr old females in household	-0.015	-2.909	-1.846	64.407
	(0.019)	(5.819)	(6.702)	(33.711)
Number of 15-60 yr old males in household	0.026	3.667	0.644	1.467
	(0.016)	(4.909)	(5.653)	(23.032)
Number of 15-60 yr old females in household	0.036	1.958	2.213	-48.719
	(0.016)	(4.963)	(5.716)	(27.853)
Number of 60+ yr old males in household	0.068	2.853	15.831	39.985
	(0.039)	(11.883)	(13.685)	(62.056)
Number of 60+ yr old females in household	-0.037	10.714	15.235	-1.835
	(0.034)	(10.395)	(11.972)	(55.963)
Log of annual household income	-0.077	-17.867	-22.395	96.100
	(0.024)	(7.421)	(8.546)	(39.178)
Scheduled tribe household head	0.016	2.851	8.499	-17.579
	(0.027)	(8.270)	(9.525)	(46.421)
Arable land ownership (acres)	0.001	0.921	1.421	-2.280
	(0.002)	(0.631)	(0.727)	(2.580)
Below poverty line ration card	-0.080	-12.334	-2.920	29.497
	(0.023)	(7.034)	(8.101)	(36.995)
Male household head	-0.108	-3.206	29.767	-35.769
	(0.071)	(21.556)	(24.825)	(106.092)
Literate mother	0.052	33.951	26.717	-139.135
	(0.031)	(9.494)	(10.934)	(46.047)
ST population in village (%)	0.001	0.244	0.123	0.196
	(0.000)	(0.150)	(0.173)	(0.862)
Distance from all weather roads (kms.)	-0.013	-1.201	-1.044	-3.693
	(0.003)	(0.842)	(0.970)	(4.780)
Male GP president	0.018	-0.803	-1.125	32.362
	(0.023)	(7.036)	(8.103)	(36.194)
Reference day was a school day±	0.792	-50.245	-51.490	
	(0.036)	(11.094)	(12.776)	

Average calories at school*reference day was a school day[±]	0.000	0.945	0.205	
	(0.000)	(0.034)	(0.039)	
Mean of average calories at school*number of 5-12 year old siblings*reference day was a school day[±]	0.000	0.017	0.740	
	(0.000)	(0.024)	(0.028)	
Constant	0.669	118.848	186.440	38.340
	(0.234)	(71.232)	(82.037)	(373.019)
F- statistic	47.03	67.24	69.12	6.77
Adjusted R^2	0.5303	0.6190	0.6256	0.1580
Observations	898	898	898	898

┼ Endogenous variable ± Instrumental variable
Robust standard errors corrected for clustering on the household, reported in parentheses.

Table 8: Impact of School Meal Nutrient Intake on Total Individual Daily Nutrient Intake

Specification	Coefficient of Quantity of Nutrient Intake from School Meal					
	Calories	Carbohydrates	Protein	Calcium	Iron	N
Cross Sectional Analysis						
(1) OLS	0.57***	0.58***	0.63***	0.67**	0.85 ***	901
	(0.127)	(0.125)	(0.127)	(0.273)	(0.145)	
(2) 2SLS	0.53***	0.55***	0.63***	0.69*	0.99***	898
	(0.159)	(0.156)	(0.158)	(0.377)	(0.178)	
(3) 2SLS	0.49***	0.52***	0.58***	0.67*	0.96***	898
	(0.187)	(0.184)	(0.191)	(0.405)	(0.233)	
(4) 2SLS	0.66**	0.75***	0.75***	0.25	0.77*	901
	(0.298)	(0.284)	(0.291)	(0.599)	(0.414)	
Community Fixed Effects						
(5) OLS	0.66***	0.65***	0.63***	0.30	0.76***	722
	(0.193)	(0.194)	(0.203)	(0.453)	(0.225)	
(6) 2SLS	0.86*	1.01**	0.61	-2.74	-0.58	243
	(0.492)	(0.465)	(0.545)	(2.043)	(0.731)	
Individual Panel						
(7) Individual fixed effects	0.76*	0.66	0.62	0.15	0.43	546
	(0.447)	(0.426)	(0.469)	(1.130)	(0.621)	

Notes: The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include dummy for child's school attendance on reference day, child's nutrient consumption from school meal, total nutrient consumption from school meal by siblings in 5-12 age group in household, child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls. The sample for specifications (1) - (6) excludes children enrolled in private schools and the currently non-enrolled.
(2) Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for attendance on reference day.

(3) Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings* dummy for school day.

(4) Actual school nutrient consumption instrumented by month of interview*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by month of interview*number of 5-12 year old siblings*dummy for school day.

(5) Model includes village dummies

(6) GP fixed effects. Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

(7) Excludes currently non-enrolled children only.
Robust standard errors corrected for clustering on the household reported in parentheses.
*Significant at 10%, ** 5% and ***1%

Table 9: Impact of School Meal Nutrient Intake on Total Individual Nutrient Intake During School

Specification	Calories		Carbohydrates		Protein		Iron		
	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	N
(3) 2SLS	0.26***	-111.12***	0.31***	-21.19***	0.37***	-4.15***	0.68***	-1.32***	873
	(0.083)	(31.239)	(0.081)	(5.689)	(0.078)	(0.982)	(0.113)	(0.519)	
(6) 2SLS	0.95***	-184.05**	0.97***	-33.72**	0.89***	-5.70***	0.66	-0.45	237
	(0.323)	(78.504)	(0.304)	(13.677)	(0.297)	(2.132)	(0.514)	(0.959)	
(7) Individual fixed effects	0.89***	-233.12***	0.85***	-42.61***	0.83***	-6.74***	0.68**	-1.32*	500
	(0.293)	(69.285)	(0.291)	(12.551)	(0.283)	(2.020)	(0.307)	(0.785)	

Notes: The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include dummy for child's school attendance on reference day, child's nutrient consumption from school meal, total nutrient consumption from school meal by siblings in 5-12 age group in household, child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls. The sample includes only children enrolled in public primary schools.

(3) Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

(6) GP fixed effects. Actual school nutrient consumption instrumented by average nutrient consumption at school* dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

Robust standard errors corrected for clustering on the household reported in parentheses.
*Significant at 10%, ** 5% and ***1%

Table 10: Impact of School Meal Nutrient Intake on Total Individual Nutrient Intake After School

Specification	Calories		Carbohydrates		Protein		Iron		
	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	N
(3) 2SLS	0.15	13.07	0.15	5.49	0.17	0.23	0.09	0.18	873
	(0.141)	(41.489)	(0.133)	(7.563)	(0.143)	(1.404)	(0.145)	(0.548)	
(6) 2SLS	-0.11	73.52	-0.14	14.71	-0.43	2.64	-1.56***	2.71	237
	(0.427)	(124.611)	(0.410)	(22.179)	(0.449)	(3.989)	(0.579)	(1.646)	
(7) Individual fixed effects	-0.06	106.64	-0.13	23.43	-0.17	5.08*	-0.33	2.18**	500
	(0.356)	(83.144)	(0.350)	(14.976)	(0.353)	(2.719)	(0.337)	(1.202)	

Notes: The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include dummy for child's school attendance on reference day, child's nutrient consumption from school meal, total nutrient consumption from school meal by siblings in 5-12 age group in household, child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls. The sample includes only children enrolled in public primary schools.

(3) Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

(6) GP fixed effects. Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

Robust standard errors corrected for clustering on the household reported in parentheses.
*Significant at 10%, ** 5% and ***1%

Table 11: Determinants of Intra-household Reallocation of Resources

Interaction Variables	**Total Individual Daily Calorie Intake**		**Total Individual Calorie Intake During School**	
	Specification			
	(1)	**(2)**	**(3)**	**(4)**
Male child	-0.07	-0.04	-0.10	-0.10
	(0.236)	(0.244)	(0.097)	(0.098)
Age	-0.01	-0.02	-0.07***	-0.07***
	(0.054)	(0.054)	(0.022)	(0.022)
Household Size	0.11*	0.11	-0.01	-0.05*
	(0.060)	(0.069)	(0.024)	(0.026)
Total Calorie Consumed by 5-12	0.00	-0.00	0.002***	0.002***
year old siblings from School Meal	(0.001)	(0.001)	(0.000)	(0.000)
Household Income	0.14	-0.02	0.08	0.18*
	(0.229)	(0.248)	(0.086)	(0.106)
N	898	898	873	873

Notes: The coefficients are reported for the interaction of actual amount of calorie consumed from the school meal by the child with the variables listed. The model corresponds to specification 3 in Table 7. In column 1 results are reported for separate regressions for each interaction term. In column 2 all the interaction terms are included in the same regression.

All regressions are OLS-IV. Robust standard errors corrected for clustering on the household reported in parentheses.

* Significant at 10%, ** 5% and ***1%

Appendix

Table A1: Impact of School Meal Calorie Intake on Total Individual Daily Calorie Intake (Specification 4 in Table 8)

	First Stage	First Stage	First Stage	Second Stage
Control Variables\ Dependent Variable	School attendance	Calories from school meal	Total Calories consumed by siblings from school meal	Total Daily Calories
School attendance†				-68.813
				(75.978)
Calories from school meal†				0.662
				(0.298)
Total calories consumed from school meal by 5-12 year old siblings residing in household†				-0.255
				(0.245)
Child's Age	0.011	2.218	-0.575	62.227
	(0.005)	(2.047)	(2.375)	(6.859)
Male child	0.009	9.062	-2.920	7.860
	(0.028)	(10.949)	(12.705)	(31.904)
Number of 5-14 yr old males in household	0.015	-0.514	2.530	-13.523
	(0.019)	(7.327)	(8.503)	(32.145)
Number of 5-14 yr old females in household	0.006	10.803	0.752	-35.397
	(0.016)	(6.227)	(7.225)	(20.967)
Number of 0-4 yr old males in household	-0.016	-12.813	-3.737	5.830
	(0.018)	(7.110)	(8.251)	(28.219)
Number of 0-4 yr old females in household	-0.014	6.030	4.879	66.118
	(0.019)	(7.440)	(8.633)	(33.580)
Number of 15-60 yr old males in household	0.027	0.184	8.906	2.679
	(0.016)	(6.278)	(7.285)	(22.999)
Number of 15-60 yr old females in household	0.035	4.602	-2.806	-54.467
	(0.016)	(6.338)	(7.354)	(27.389)
Number of 60+ yr old males in household	0.070	21.675	41.091	40.707
	(0.039)	(15.255)	(17.702)	(62.293)
Number of 60+ yr old females in household	-0.039	-10.617	-6.563	-0.516
	(0.034)	(13.252)	(15.377)	(54.966)
Log of annual household income	-0.080	-13.012	-19.471	97.823
	(0.024)	(9.514)	(11.039)	(38.905)
Scheduled tribe household head	0.016	17.570	21.310	-9.790
	(0.027)	(10.572)	(12.267)	(46.687)
Arable land ownership (acres)	0.001	-0.231	0.001	-2.344
	(0.002)	(0.806)	(0.935)	(2.576)
Below poverty line ration card	-0.080	-13.027	-3.327	36.448
	(0.023)	(9.014)	(10.460)	(36.985)
Male household head	-0.114	-35.780	-8.349	-23.710
	(0.071)	(27.659)	(32.095)	(105.685)
Literate mother	0.050	13.740	-0.544	-140.366
	(0.031)	(12.128)	(14.073)	(46.431)
ST population in village (%)	0.001	-0.097	-0.353	-0.014
	(0.000)	(0.192)	(0.223)	(0.877)
Distance from all weather roads (kms.)	-0.013	-1.387	-0.887	-3.581

	(0.003)	(1.074)	(1.247)	(4.741)
Male GP president	0.015	-4.584	-12.796	32.837
	(0.023)	(9.043)	(10.493)	(36.170)
Reference day was a school day±	0.753	-87.406	-94.171	
	(0.047)	(18.381)	(21.329)	
Month of interview*reference day was a school day±	0.030	181.019	87.341	
	(0.028)	(11.048)	(12.820)	
Mean of average school calories*number of 5-12 year old siblings*reference day was a school day±	0.009	-14.070	67.450	
	(0.013)	(5.151)	(5.977)	
Constant	0.705	134.010	214.345	-25.040
	(0.236)	(92.413)	(107.235)	(372.487)
F- statistic	47.50	25.37	25.47	6.38
Adjusted R^2	0.5320	0.3733	0.3743	0.1579
Observations	901	901	901	901

┼ Endogenous variable ± Instrumental variable

Robust standard errors corrected for clustering on the household, reported in parentheses.

Table A2: Impact of School Meal Calorie Intake on Total Individual Daily Calorie Intake (Specification 6 in Table 8)

	First Stage	First Stage	First Stage	Second Stage
Control Variables\ Dependent Variable	School attendance	Calories from school meal	Total Calories consumed by siblings from school meal	Total Daily Calories
School attendance†				-129.680
				(162.690)
Calories from school meal†				0.862
				(0.492)
Total calories consumed from school meal by 5-12 year old siblings residing in household†				-0.097
				(0.306)
Child's Age	0.004	5.501	-2.501	70.815
	(0.010)	(3.114)	(2.446)	(12.035)
Male child	-0.044	11.696	-12.144	25.532
	(0.057)	(17.353)	(13.631)	(62.618)
Number of 5-14 yr old males in household	-0.016	-11.490	2.879	38.754
	(0.032)	(9.715)	(7.632)	(51.322)
Number of 5-14 yr old females in household	0.041	12.593	4.939	-6.297
	(0.026)	(7.924)	(6.224)	(35.678)
Number of 0-4 yr old males in household	-0.053	-9.691	5.845	13.865
	(0.034)	(10.525)	(8.267)	(52.639)
Number of 0-4 yr old females in household	-0.018	-5.486	-8.373	-14.032
	(0.037)	(11.226)	(8.818)	(59.155)
Number of 15-60 yr old males in household	0.028	11.582	-4.852	64.789
	(0.034)	(10.515)	(8.260)	(44.645)
Number of 15-60 yr old females in household	0.036	-3.745	0.674	-88.498
	(0.032)	(9.744)	(7.654)	(45.209)
Number of 60+ yr old males in household	0.006	-12.460	-28.196	87.462
	(0.084)	(25.724)	(20.207)	(103.441)
Number of 60+ yr old females in household	-0.143	-29.480	-24.181	53.036
	(0.063)	(19.266)	(15.134)	(117.190)
Log of annual household income	-0.066	-22.461	-3.659	104.613
	(0.055)	(16.895)	(13.272)	(82.334)
Scheduled tribe household head	-0.030	-4.772	-1.185	64.584
	(0.053)	(16.089)	(12.638)	(67.202)
Arable land ownership (acres)	0.000	-0.156	-0.358	-4.757
	(0.004)	(1.273)	(1.000)	(4.849)
Below poverty line ration card	-0.109	-28.162	-18.947	74.005
	(0.049)	(14.850)	(11.665)	(70.496)
Male household head	0.093	27.633	18.124	-36.104
	(0.130)	(39.754)	(31.228)	(141.369)
Literate mother	0.204	64.651	33.091	-231.241
	(0.067)	(20.502)	(16.105)	(90.679)
ST population in village (%)	-0.005	-1.565	-1.157	-1.746
	(0.002)	(0.557)	(0.437)	(2.455)
Distance from all weather roads (kms.)	0.000	-0.023	6.083	-11.441
	(0.013)	(3.885)	(3.052)	(19.551)
Male GP president	0.245	21.870	17.483	0.334

	(0.103)	(31.639)	(24.854)	(128.144)
Reference day was a school day±	1.142	19.910	12.391	
	(0.118)	(36.105)	(28.362)	
Average school calories*reference day was a school day±	-0.001	0.804	0.058	
	(0.000)	(0.101)	(0.079)	
Mean of average school calories*number of 5-12 year old siblings*reference day was a school day±	0.000	0.183	0.945	
	(0.000)	(0.049)	(0.038)	
Constant	0.588	213.174	89.248	-213.346
	(0.500)	(152.998)	(120.185)	(721.716)
GP Dummies	Yes	Yes	Yes	Yes
F-statistic	13.33	16.62	57.91	4.10
Adjusted R^2	0.5603	0.6074	0.8546	0.3041
Observations	243	243	243	243

┼ Endogenous variable ± Instrumental variable
Robust standard errors corrected for clustering on the household, reported in parentheses.

Table A3: P values for F tests of Coefficient of Quantity of Nutrient Intake from School Meal Equivalent to 1

Specification	Calories		Carbohydrates		Protein		Calcium		Iron	
	Dependent Variable									
	Total Daily Intake	Total Intake During School	Total Daily Intake	Total Intake During School	Total Daily Intake	Total Intake During School	Total Daily Intake	Total Intake During School	Total Daily Intake	Total Intake During School
(3) 2SLS	0.49***	0.26***	0.52***	0.31***	0.58***	0.37***	0.67*	0.62***	0.96***	0.68***
	(0.187)	(0.083)	(0.184)	(0.081)	(0.191)	(0.078)	(0.405)	(0.115)	(0.233)	(0.113)
P value	*0.01*	*0.00*	*0.01*	*0.00*	*0.03*	*0.00*	*0.44*	*0.00*	*0.88*	*0.01*
(6) 2SLS	0.86*	0.95***	1.01**	0.97***	0.61	0.89***	-2.74	1.02**	-0.58	0.66
	(0.492)	(0.323)	(0.465)	(0.304)	(0.545)	(0.297)	(2.043)	(0.442)	(0.731)	(0.514)
P value	*0.78*	*0.87*	*0.98*	*0.91*	*0.48*	*0.72*	*0.07*	*0.96*	*0.03*	*0.51*
(7) Individual fixed	0.76*	0.89***	0.66	0.85***	0.62	0.83***	0.15	0.75***	0.43	0.68**
effects	(0.447)	(0.293)	(0.426)	(0.291)	(0.469)	(0.283)	(1.130)	(0.269)	(0.621)	(0.307)
P value	*0.59*	*0.71*	*0.42*	*0.60*	*0.42*	*0.56*	*0.46*	*0.34*	*0.36*	*0.31*

Notes: The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include dummy for child's school attendance on reference day, child's nutrient consumption from school meal, total nutrient consumption from school meal by siblings in 5-12 age group in household, child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls. The sample includes only children enrolled in public primary schools.

(3) Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

(6) GP fixed effects. Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

Robust standard errors corrected for clustering on the household reported in parentheses.
*Significant at 10%, ** 5% and ***1%

Table A4: Impact of School Meal Nutrient Intake on Total Individual Nutrient Intake Before School

Specification	Calories		Carbohydrates		Protein		Iron		
	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	Quantity of Nutrient from School Meal	School Attendance	N
(3) 2SLS	0.04	3.98	0.04	1.49	0.09	0.16	0.13	-0.31	873
	(0.105)	(34.464)	(0.100)	(6.438)	(0.103)	(1.126)	(0.118)	(0.569)	
(6) 2SLS	0.33	-64.02	0.40	-12.42	0.11	-0.40	-0.98*	2.14	237
	(0.432)	(95.625)	(0.424)	(16.691)	(0.440)	(2.697)	(0.549)	(1.370)	
(7) Individual fixed effects	0.26	-28.56	0.23	-4.258	0.20	0.02	0.12	-0.26	500
	(0.261)	(65.318)	(0.257)	(12.080)	(0.265)	(2.103)	(0.282)	(0.927)	

Notes: The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include dummy for child's school attendance on reference day, child's nutrient consumption from school meal, total nutrient consumption from school meal by siblings in 5-12 age group in household, child's age, sex, current grade, log annual household income, household's agricultural land ownership, caste and sex of head of household, mother's literacy status, whether the household has a below poverty ration card, eight household composition variables, percentage of ST population in village, distance to all weather road from village and a dummy for male GP president as controls. The sample includes only children enrolled in public primary schools.

(3) Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

(6) GP fixed effects. Actual school nutrient consumption instrumented by average nutrient consumption at school*dummy for school day; school attendance on reference day instrumented by dummy for school day; total nutrient consumption from school meal by siblings instrumented by mean of average nutrient consumption at school*number of 5-12 year old siblings*dummy for school day.

Robust standard errors corrected for clustering on the household reported in parentheses.
*Significant at 10%, ** 5% and ***1%

Figure A1: Systematic Random Sampling of Households in a Representative Village

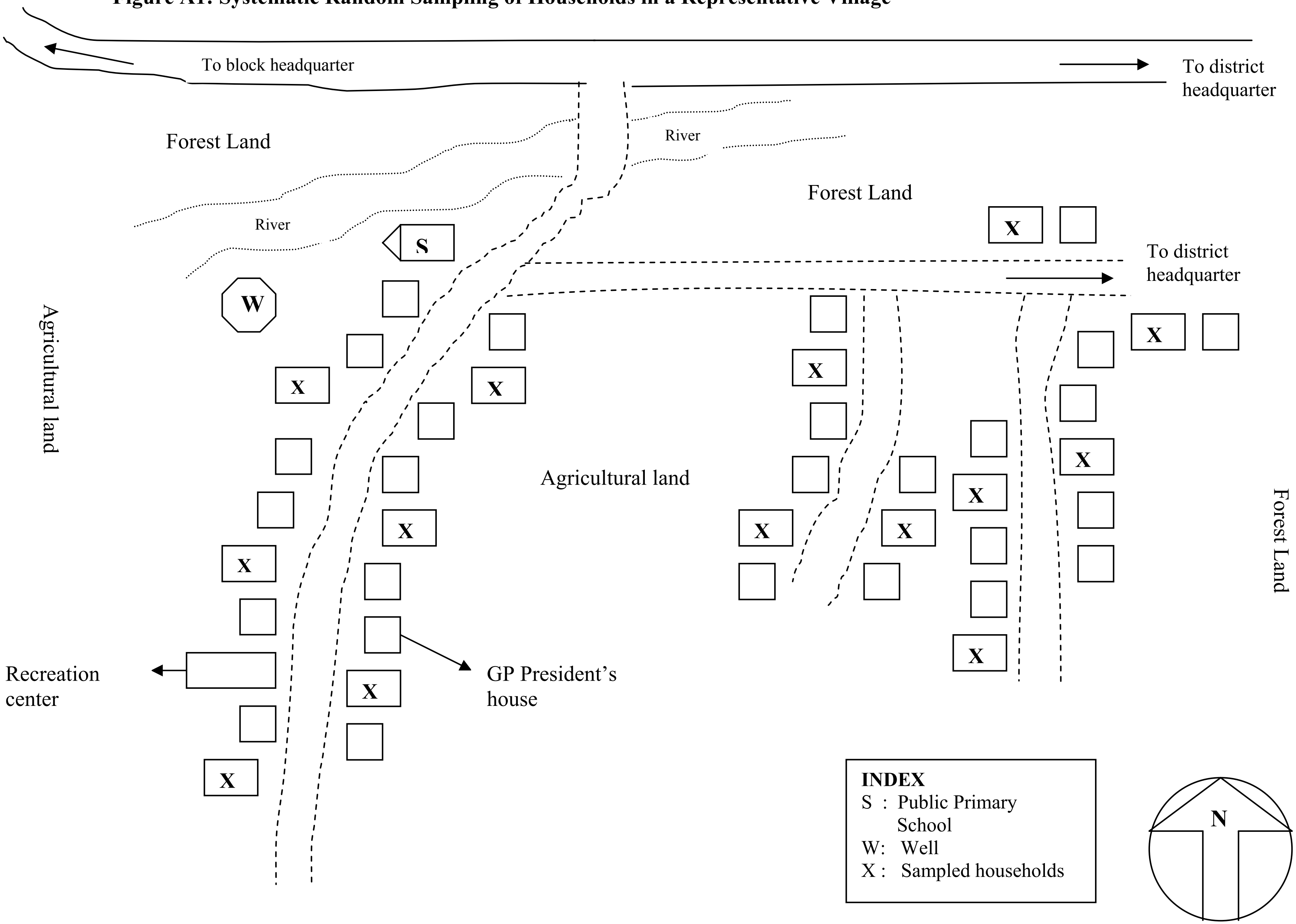

Figure A2: Time Line of Program Implementation in the Survey Area

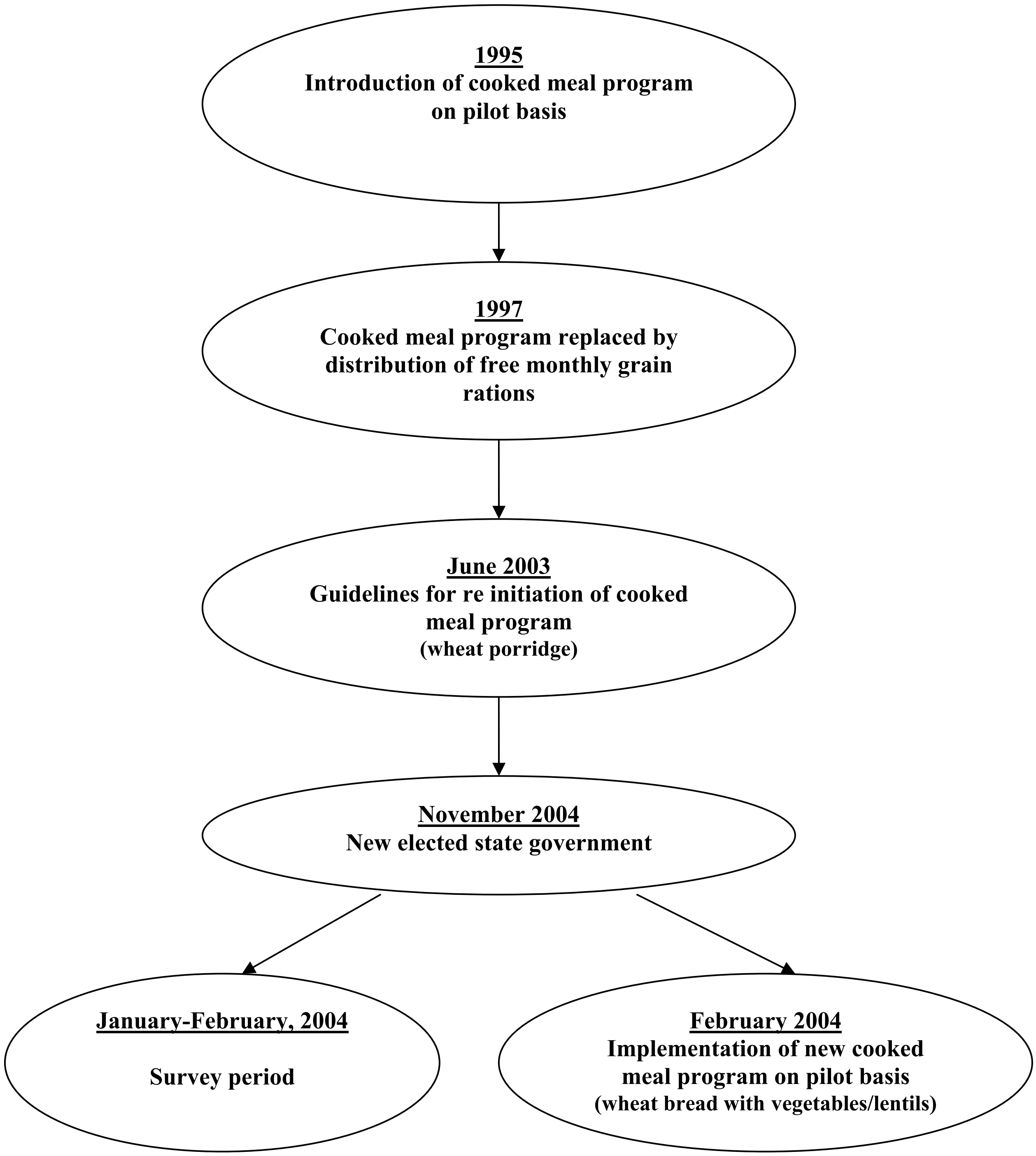

Table A5: Official Guideline for Expenditure on Mid Day Meal Program in Survey Area (Rs. per 100 students per day)

Expenditure Category	**Mid Day Meal Program**		
	Old Program	**New Program**	
		Menu 1	**Menu 2**
1 Milling of wheat	9.50	10	10
2 Lentils	0	50	0
3 Oil	11	5	15
4 Sugar	13	0	0
5 Milk	0	0	0
6 Vegetables	0	0	30
7 Salt and Spices	1.50	15	20
Total Cost of Ingredients	**35**	**70**	**75**
8 Fuel	8	10	10
9 Cook's Salary	15	40	40
Total Cost	**58**	**130**	**125**

Source: Department of Panchayat and Rural Development, Government of Madhya Pradesh.

Table A6: Design of the Consumption Recall Survey

Record what and how much food the child consumed yesterday. *Spend time with both mother and child to record accurately what the child ate from the moment the child woke up to the moment the child went to bed at night. As far as possible, observe the consistency and ingredients of the food item otherwise interview the mother in detail. Use separate line for each food item and each ingredient.*

Child ID ☐

1. Did the child attend school yesterday? (0) No (1) Yes ☐

2. If yes, was the child offered cooked meal at school yesterday? (0) No (1) Yes ☐

3. If yes, did the child consume the cooked meal yesterday? (0) No (1) Yes ☐

Time	Food Item	Quantity of food item in household measurement	Consistency of Food Item	Raw Ingredient in Food Item	Quantity of raw ingredient (gms.)

Note: Put a tick mark (√) in front of the food item cooked/received in school.

Each field worker was provided with 3 options for size of plates, bowls and glasses, 4 options for the size of bread and 3 options for the thickness of bread to be shown to the respondent. In addition, they were trained to observe 3 options for thickness and consistency of cooked vegetables, lentils and other commonly prepared meals in the survey region and provided with standardized illustrations of sizes of raw foods such as fruits to be shown to respondents. Weighing scales were provided for estimating the weight of unexpected raw foods eaten. All raw ingredients in each food item was noted (excluding water, salt and other spices) on the field and converted into raw grams after the field survey. The standardization of the quantity of raw ingredients was based on the observation of food cooked by households in the field, including the intake of oil in the food, and reproduction of each observed and recorded food item in a laboratory off the field. The raw ingredients were coded and converted into calories using software based on the guidelines provided by the Indian Council of Medical Research.