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Child welfare programs and child nutrition: Evidence from a mandated school meal program in India☆

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ABSTRACT

Utilizing the data I collected on a nationally mandated school meal program in India, I examine the extent to which children benefit from the targeted public transfer. Relying upon built-in randomness in whether a child's 24-hour food consumption recall was for a school or non-school day, I find that the daily nutrient intake of program participants increased substantially by 49% to 100% of the transfers. The results are robust to the potential endogeneity of program placement and individual participation. The findings suggest that for as low a cost as 3 cents per child per school day the scheme reduced the daily protein deficiency of a primary school student by 100%, the calorie deficiency by almost 30% and the daily iron deficiency by nearly 10%. At least in the short-run, therefore, the program had a substantial effect on reducing hunger at school and protein–energy malnutrition.

Policy initiatives in developing countries often aim to address the challenge posed by low levels of health and educational attainment among the vulnerable sections of its population, particularly children. A relevant question is to what extent children benefit from welfare programs targeted at them. 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 could lead to relatively small gains to the transfer recipients. In this paper I test this implication of household behavior by analyzing the impact of a nationally mandated school meal program on children's daily consumption of nutrients in a rural area of India.

Besides evaluating the efficacy of child welfare programs, the estimation of the magnitude of the impact of supplementary feeding programs on child nutrition is a goal in itself. South Asia accounts for the largest proportion of children suffering from stunting and wasting in the world (United Nations Children's Fund (UNICEF), Report of the Commission on Nutrition Challenges of the 21st Century, 2000). Almost 50% of pre-school children in rural India are malnourished (National Family Health Survey (NFHS), 1998–99). 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 these children (Behrman, 1996).

The existing literature on public transfers to children has focused primarily on indirect measures of the impact on individual consumption, such as aggregate household expenditure, long-term child health and cognitive ability.[1] While these outcome measures are important, they do not inform us about the extent of 'leakage' of transfers to a child through redistribution of family resources. Despite the growing emphasis on school meals as a channel for improving child health and educational outcomes, there exists little conclusive quantitative evidence on the impact of supplementary feeding programs in

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[1] Studies have found positive effects of food transfers on *school participation* (Vermeersch and Kremer, 2005; Ahmed and Del Ninno, 2002; Dreze and Kingdon, 2000; Ravallion and Wodon, 2000) of children. But evidence on the effects on *cognitive ability* (Vermeersch and Kremer, 2005; Jacoby et al., 1996; Martorell, 1995) and on *long-term health indicators* (Vermeersch and Kremer, 2005; Martorell, 1995; Beaton and Ghassemi, 1982) of children is ambiguous.

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improving nutrient intake of *individual recipients* in developing countries.[2] In a study of a largely urban school meal program in the Philippines, Jacoby (2002) uses the randomness in the assignment of school and non-school day to respondents in schools with and without the program to find no evidence of a reallocation of calories away from program participants. This paper adopts a similar strategy to identify program impact in a *rural* setting with several significant advantages over the existing literature.

First, the paper utilizes primary data I collected in the central Indian state of Madhya Pradesh (MP), an area that transitioned from providing free, raw food grains to cooked meals in schools. This allows me to study the relative impact of the two programs on child health. Second, randomization of school and non-school day is built into the self-designed survey essentially formalizing, rather than *assuming*, exogeneity of date of interview as in Jacoby (2002). Third, the survey includes individual level *panel data* on children whose dietary intakes were collected on two consecutive days, a school and a non-school day. This allows addressing concerns about unobservable individual heterogeneity influencing program participation which has until now been unexplored in the literature on school meals in developing countries. Individual fixed effects analysis allows us to draw firm policy conclusions and provide more powerful evidence about household behavior. Fourth, in this study randomization of school/non-school day is over a period of less than 2 months during which there is no seasonal variation in either household food security or the types of foods consumed. A comparison of nutrient intake between school days during one season with non-school days in a different season (viz. Jacoby, 2002) could introduce systematic biases in the comparison of nutritive intakes between the two types of days. The methodology adopted in this paper minimizes, if not eliminates, this complication in interpreting the results. Fifth, individual level data on daily intake of essential nutrients other than just calories through a 24-hour food consumption recall enables me to assess the impact the *quality* of the school meals might have on nutrient reallocation by households in response to the public transfer. The close comparability of the quality of the school and home meals allows a finer test of households' resource allocation behavior than in Jacoby (2002). Finally, the 'on-site' cooked school meal program in India allows identification of the child as the final recipient of the transfer. Since the transfer is unlikely to affect the existing power structure in the household, the interpretation of the program effect is not complicated by changes in bargaining power unlike cash or in-kind 'take-home' programs such as Progresa (Behrman and Hoddinott, 2005; Schultz, 2004).

The empirical methodology, adopted in this paper, progressively approaches the ideal of randomized program evaluation to assess program impact. In the data there exist communities which implemented the cooked meal program and those which did not. I begin by assuming that community participation in the program is arbitrarily distributed across the survey region and use the randomness in whether the child's diet recall was for a school day (a day she/he was served a supplementary meal in school) or a non-school day (a day on which she/he did not receive the food transfer) to identify the effect on daily nutrient consumption. Next, to investigate whether the results obtained from the cross-sectional analysis are robust to unobserved community characteristics, the assumption of random program implementation is relaxed by estimating the difference in the average daily nutrient intake of children who participated and did not participate in the school meal program on the reference day in a community fixed effects specification. In a final robustness check I account for individual level heterogeneity by adopting a difference-in-differences strategy in a child fixed effects model.

The point estimates for the share of nutrient transfers by which a child's daily intake rises are in the range of 49% to 100%, indicating that a substantial proportion of the transfers benefit the recipient. A disaggregation of the total daily consumption data into intake of nutrients during school and non-school hours strengthens this conclusion. Analysis suggests that program participants' total nutrient intake during school hours increases by almost the full amount of the transfer from school meals, especially in the preferred specifications that control for endogenous program placement and individual fixed effects. The point estimates, however, are smaller in magnitude than the effect on daily calorie intake from consuming school meals in Philippines (Jacoby, 2002) and vary across nutrients. Thus the increase in participants' consumption may not be one-for-one for all transfer nutrients.

In light of the existing evidence on inequality in allocation of resources within a household (Pitt et al., 1990; Behrman, 1988), I examine whether the magnitude of the nutritional benefits to the child from the program vary by individual and household characteristics.[3] The results point towards some heterogeneity in the response of households to the program. The program may be potentially effective in reducing gender disparities in the nutritive intakes of children in India (Pitt et al., 1990) and also in benefiting younger program participants more. From a policy perspective, this finding is encouraging since health interventions in early stages of growth of children are more likely to produce long-term benefits.

The findings of this paper indicate that the gains from the program are non-trivial. At a cost of between 1.44 cents to 3.04 cents per child per school day the scheme improved nutritional intakes by reducing the daily protein deficiency of a primary school student by 100%, the calorie deficiency by almost 30% and the daily iron deficiency by nearly 10%. In the short-run, therefore, the program can have a substantial effect on reducing hunger at school and protein–energy malnutrition of the 119 million school children currently covered under it across India.[4] An indirect channel through which school-based health interventions can improve long-term outcomes is improved school participation resulting from better health (Bobonis et al., 2006; Miguel and Kremer, 2004). Recent direct evidence available for developing countries suggests that early-childhood interventions have a significant effect on long-term educational attainment and cognitive ability (Maluccio et al., 2007). Thus school meals may well have long-term implications for the economic well-being of primary school children in terms of higher earnings potential in their adulthood.

The remainder of the paper is organized as follows. The background on the school meal scheme in India and the analytical framework of the paper are discussed in section 1. The details of the design and implementation of the survey and the data are presented in section 2 along with the empirical strategy. The empirical results are presented in section 3 while section 4 discusses the policy implications of the results and concludes.

[2] While research on the National School Lunch Program (NSLP) and School Breakfast Program (SBP) in the U.S. show benefits of the programs on the 24-hour intake of nutrients by participating children (Bhattacharya et al., 2006; Gleason and Suitor, 2003; Devaney and Fraker 1989; Akin et al., 1983), in a survey of eight pre-school feeding programs in developing countries (including India), Beaton and Ghassemi (1982) find that only 10% to 25% of the existing energy gap of the target population was closed in both 'take-home' and 'on-site' programs. However, randomized small sample studies such as the INCAP in Guatemala (Martorell, 1995) and a school breakfast program in Peru (Jacoby et al., 1996) found significant improvements in the energy and nutrient intakes of participants.

[3] Studies which *indirectly* evaluate the impact of public transfers on child consumption have found larger benefits to girls (Schultz, 2004; Dreze and Kingdon, 2000) and children of poorer households (Behrman and Hoddinott, 2005). To the best of my knowledge only Jacoby's (2002) paper has analyzed variation of the *direct* impact on individual consumption by a range of individual and household characteristics. He finds that the proportion of transfers by which daily calorie intake rises is lower for children of poor households but there is no variation in program effect by age, gender or household composition.

[4] Status of the program as of 2005–06 is available on the website of the Department of School Education and Literacy, Government of India at http://education.nic.in/mdm/mdm.asp.

1. Background

1.1. The school feeding program in India

I now turn to explaining the nature of the school meal program in India. The federal government in India launched the National Program of Nutritional Support to Primary Education in August 1995 (Government of India, 1995). The program mandated cooked meals in public primary (*not* in private primary schools) across all states in the country.[5] Each enrolled child was to be served a free meal cooked out of 100 g of raw wheat or rice grains (depending on whether it was a wheat or rice eating area) per school day on the school premises during the lunch break (or mid-day and hence called the mid-day meal (MDM) program). The state governments were responsible for financing the cost of converting food grains, provided free by the federal government, into cooked meals. States which could not raise resources were allowed, in the interim, to distribute free grain rations to each enrolled child at the rate of 3 kg per month for a 10-month academic year subject to a minimum monthly attendance of 80% by the student. A Supreme Court of India judgment in 2001 directed all state governments, which were yet to implement the program, to provide cooked meals in all targeted schools within 6 months.

1.2. The school feeding program in the survey region

I designed and conducted the survey from January through February 2004, in the rural areas of one of the eleven census blocks of Chindwara district of MP.[6] While the poverty ratio in non-urban areas of India was about 26% in 1999–2000, rural poverty in MP was more than 30% (Deaton and Dreze, 2002). 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.

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 selected block public primary schools were providing 2 kg of free raw food grains every school month to all enrolled students up until April 2003, despite the court verdict mandating cooked school meals in 2001.[7] This area transitioned from distribution of free grain rations to the cooked meal program only in July 2003 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 on February 1st, 2004 by a recently elected state government.[8]

But the school meal program had not been implemented uniformly across all targeted schools in this region at the time of the survey. The directly elected Gram Panchayat (GP), which is the executive body at the village level, had the principal administrative and financial responsibility of implementing the program in all the public primary schools within its purview.[9] Each GP represents at least a 1000 people, typically consisting of residents of one to three villages (and one to two public primary schools within each village). The sarpanch (president) of the GP who is directly elected is primarily responsible for decisions made by the GP. While some GPs had implemented the feeding program in schools within their jurisdiction during the survey period others had not, possibly due to some unobservable political and financial reasons. Due to the democratic nature of this program enforcement body, therefore, the implementation of the school meal scheme could be endogenous to GP characteristics.

Table 1
Summary statistics.

Variable	Obs.	Mean	Std.	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 (kcal)	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
Male head of household	1096	0.98	0.15	0	1
Scheduled tribe head of household	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.)[a]	1096	21,807.56	19,207.00	2913	211,777.7
Below poverty line	1096	0.50	0.50	0	1
Arable land ownership (acre)	1096	4.35	6.79	0	70

Notes: The grade of children enrolled in kindergarten is coded as 0. Missing observations on literacy of mother/father in single parent families.
[a] Annual income includes the value of agricultural output (either for sale or self consumption), wage, salary and self employment income, cash or in-kind transfers, income from sale of forest produce and from sale of or rent from other fixed and mobile assets.

1.3. Analytical framework

It is reasonable to assume that during early childhood the consumption of a child is almost completely within the control of parents. One can then analyze the impact of a public transfer to the child within the unitary framework of the household. Consider a household consisting of a child j, who is a recipient of transfers from a welfare program and other members $-j$, who are non-recipients. The household maximizes its utility from daily consumption of good C, the good subsidized by the in-kind public transfer to j, and a vector of other goods $\mathbf{X}$. The quantity of C and $\mathbf{X}$ consumed is a function of $\boldsymbol{\eta}$, a vector of individual, household and community level characteristics.

$$\text{Max.}\quad U = U\left(C^j, C^{-j}, \mathbf{X}^j, \mathbf{X}^{-j}; \boldsymbol{\eta}\right) \tag{1}$$

subject to the household budget constraint over a planning horizon,

$$\mathbf{p}'\left(\mathbf{X}^j + \mathbf{X}^{-j}\right) + p_c\left(C^j + C^{-j}\right) \leq Y \tag{2}$$

where, $\mathbf{p} = (p_1, p_2 \ldots\ldots, p_n)$ is a vector of prices for n goods, X while p_c is the price of C. Y is exogenously given household income. For simplicity, I assume that prices of both C and $\mathbf{X}$ are also exogenous to the household. The first order conditions lead to the usual utility

[5] In most Indian states primary school consists of grades 1 to 5.

[6] Districts in India are subdivided into census blocks. In 2001 there were a total of 48 districts and 311 census blocks in MP.

[7] 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. Thus, the quantity of raw food grains a child was entitled to under the cooked and monthly grain distribution programs were equivalent.

[8] Under the initial school feeding program, schools were directed through state government guidelines to provide *porridge* (either sweet or salty) cooked from 100 g of raw wheat such that a total of 413.80 kcal and 8.20 g of protein are provided per student per school day. In the new pilot program beginning February, the targeted schools were to serve *bread* (roti) from 100 g of wheat grains along with either 60 g of *vegetables* or 20 g of *lentils* per child per school day. The per child per day cost of the new program was almost double the old one.

[9] Under the guidelines of the state government of MP, GPs were expected to use funds obtained through devolution of revenue collected by state governments to finance the school meal program.

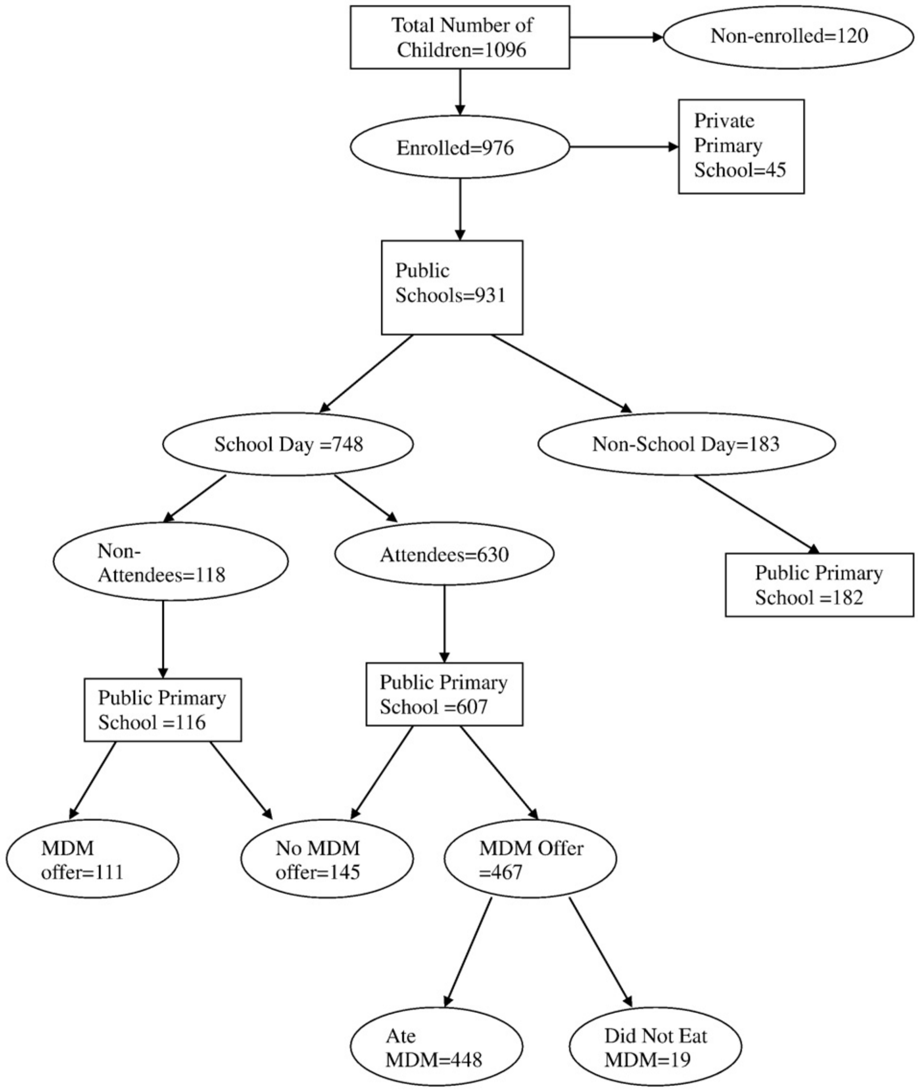

Fig. 1. Sample distribution.

maximization conditions which state that the household will equate the marginal rate of substitution between C^j and C^{-j} (and between C^j and any good n in vector $\mathbf{X}$) to the ratio of the prices of the two goods.

On a school day, the child receives an in-kind transfer during school hours, increasing C^j. Assuming that the meal program does not affect the relative prices, then given the utility maximization condition and the neo-classical properties of the utility function, the household will withdraw resources from C^j and redistribute it to the non-subsidized goods, $\mathbf{X}^j$ and to the non-participants in the program, $-j$, respectively. Thus the total increase in the consumption of the subsidized good, C^j, would be equivalent to the income effect of the transfer program but less than the full amount of the transfer due to the resource redistribution.

The change in the consumption of C^j can theoretically be smoothed across the relevant planning horizon of the household. For simplicity, presuming that the transfer is infra-marginal to the amount of calories the child would have consumed during school hours in the absence of the program, if reallocation occurs only *within* a day then C^j would increase by the income effect on the day of the transfer receipt. However, if the household smoothes the increase in Y due to the program *across* days, then the effect of the program on the child's consumption of the subsidized good on *all* days would be equivalent to an income effect from a transfer to the household as a whole. Thus, the theoretical prediction from the unitary household model with complete fungibility of resources over time is that a difference in the consumption of C^j on school and non-school days is nil. This leads to an erroneous inference of zero program effect. In the analysis, therefore, I compare the average daily consumption of the subsidized good by children participating in the transfer program between a school and non-school day as well as between meals, within a day. To the extent that the implied income elasticity of nutrient consumption in developing countries is negligible (Behrman and Deolalikar, 1987) and nutrient substitution occurs only within a day, my strategy of differencing daily nutrient intakes between a school and non-school day should give a true assessment of the program's effect.[10]

2. Data and empirical strategy

2.1. Survey data

Of a total of 150 villages in the selected census block of MP, 41 villages were randomly chosen to be surveyed on an *exogenously* determined

[10] Other than an income effect, the school meal program also has a price effect. The program makes schooling cheaper and potentially raises participation rates (Afridi, 2007). This would be a concern in the analysis if the children whose participation rates are affected are systematically different in unobservable characteristics. The individual fixed effects methodology will address any selection on individual level unobservables in the analysis.

Table 2
Summary statistics by type of day and program status (public primary schools).

Variable	Type of day		
	Non-school day	School day	Difference
	($N=182$)	($N=723$)	
	(1)	(2)	(3)
Male	0.51 (0.037)	0.52 (0.019)	−0.01 (0.041)
Age	8.73 (0.176)	8.78 (0.079)	−0.05 (0.181)
Current grade	2.80 (0.107)	2.95 (0.053)	−0.15 (0.119)
Mother literate	0.16 (0.028)	0.15 (0.014)	0.01 (0.030)
Father literate	0.45 (0.038)	0.49 (0.019)	−0.03 (0.042)
Male head of household	0.98 (0.011)	0.97 (0.006)	0.01 (0.013)
Scheduled tribe head of household	0.40 (0.036)	0.57 (0.018)	−0.18*** (0.041)
Number of household members	6.88 (0.207)	6.47 (0.066)	0.41** (0.168)
Number of 5–12 year old siblings residing in household	1.31 (0.074)	1.12 (0.031)	0.18** (0.072)
Total annual household income (Rs.)	21,416.94 (1011.09)	20,776.35 (680.142)	640.59 (1447.65)
Below poverty line	0.41 (0.037)	0.52 (0.019)	−0.10** (0.041)
Arable land ownership (acre)	3.38 (0.382)	3.90 (0.208)	−0.52 (0.457)

Notes: Standard errors in parentheses.
*Significant at 10%, **5% and ***1%.

interview date. Within each village, 15 households were surveyed through systematic random sampling. In all sampled households of a village, children in the age group of 5 to 12 years were administered a 24-hour food consumption and activity recall survey for the previous day on the *same* interview date (implying no within-village variation in the date of interview).[11] While children in some villages recalled their food consumption on a school day, children in other villages recalled consumption for a non-school day, typically a Sunday or a public holiday.[12] 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 reference day. A random sub-sample of 12 villages was revisited to collect the dietary and activity recall data of the same child on both a school and non-school day. These were those 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. A total of 615 households, 74 primary schools (both public and private) and 41 villages were surveyed in the first visit. A sub-sample of 180 households in 12 villages was revisited.

From the initial visit, 1096 children's dietary data are available. The summary statistics for this sample are presented in Table 1. 89% of the children were currently enrolled in a primary school (Currently Enrolled). More than half the population consists of scheduled tribes (ST)[13] (Head of Household ST) and is poor, with more than 50% of the sampled families included in the district administration's list of below poverty line households (Below Poverty Line).[14] Fig. 1 shows that of

Table 3
Nutrient consumption by program participants on reference day.

Nutrient (unit)	Total daily consumption	Consumption from school meal	Percentage of total daily consumption from school meal
($N=448$)	(1)	(2)	[(2)/(1)]*100
Calories (kcal)	1379.80 (440.99)	263.06 (128.22)	19.07
Carbohydrates (g)	261.17 (83.29)	48.66 (25.77)	18.63
Protein (g)	42.45 (14.35)	8.27 (4.60)	19.48
Calcium (mg)	145.84 (113.88)	32.74 (19.87)	22.45
Iron (mg)	13.04 (6.21)	3.46 (1.78)	26.53

Notes: Standard deviations in parentheses.

the 931 children in public schools (including public *secondary* school students whose schools were *not* mandated to serve meals), the reference day was a school day for 748 and 630 of them attended school on that day. However, because of non-implementation or irregularity of the program, only 467 of the 607 public primary school children were offered school meals on the reference day.[15] Food consumption from school meals is designated as zero for those children whose schools did not offer meals—those providing free grain rations or those not serving cooked meals in the week before the survey. The uptake of the cooked meal program was nearly universal with only 19 children not consuming the meal offered to them.

Table 2 describes the individual and household characteristics by the type of reference day (school/non-school) for public primary school students. If randomization of the day of interview worked then there should not be any significant differences in the observable sample characteristics between the two types of days. However, looking down column 3 we find that children for whom the reference day was a school day were more likely to belong to an ST and below poverty line household and have slightly fewer household members. But the former differences go against finding a positive effect of the program on daily nutritional intake since poorer children are likely to be relatively more malnourished. Further, the analysis will control for these observable differences between the two groups.

In the empirical analysis I study the impact of the meal program on five nutrients—energy or calories, carbohydrates, proteins, calcium and iron—whose deficiency in children is among the highest in India (Gopalan et al., 2004). Table 3 shows that the meal program provides a significant proportion of the daily intake of these five nutrients by children who ate a school meal on the reference day. For instance, school meals provided 263 kcal which constitutes more than 19% of the total daily calorie intake of the participants on the reference day.

Before turning to the estimation strategy, the raw distribution of the daily calorie and protein intake of the children participating in the old and new cooked meal program and non-participants on the reference day is presented in Figs. 2 and 3. Individual participation in the program is defined as school attendance and consumption of a school meal on the reference day. Non-participation in the program may have arisen either due to a non-school day or non-provision of school meals on a school day. Fig. 2 suggests that the daily calorie intake of those consuming a school meal on the reference day was higher compared to non-participants. The distribution function also indicates that participants in the new school meal program had marginally higher calorie intake

[11] The official primary school going age is in the range of 6 to 10 years. A broader age group accounts for early enrollment or grade repetition. Approximately 2% of the sample consists of children who are in the age group of 13 to 14 years and still enrolled in a primary school.

[12] The public holidays did not include any festival during which food consumption would be expected to be systematically different from other days. But a drawback of the survey is that information is not available on the daily food consumption of other household members (infants and adults) or of goods other than food to which resources could be redistributed in response to the program. See Appendix A for the design and details of the 24-hour consumption recall survey.

[13] 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 (ST).

[14] The state government of MP conducts an annual survey of households to classify them as above or below poverty line.

[15] Of the total number of children enrolled in public primary schools, 51% were being served wheat porridge under the old scheme, 30% of the children were being offered 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 grain rations. The last category of children was offered school meals during the 4 months prior to the survey interview and for at least half of the school month prior to the interview. Judging from the field interviews, the reasons for irregularity of the scheme in these schools were idiosyncratic and 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.

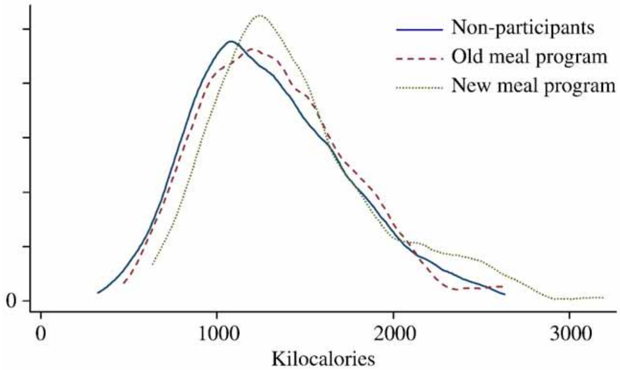

Fig. 2. Distribution of total daily calorie intake by program participation status.

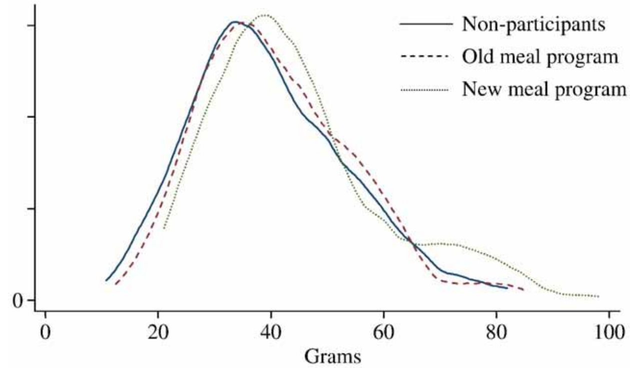

Fig. 3. Distribution of total daily protein intake by program participation status.

compared to the students participating in the old meal program. Similar conclusions can be reached from Fig. 3. These observations, however, do not account for the observable or unobservable differences between program participants and non-participants.[16]

2.2. Empirical strategy

The program implementing agency is the GP, each with one to three villages within its jurisdiction, and the characteristics of the villages and the school meal program within a GP are likely to be homogenous. Given this institutional characteristic of the program, the ideal estimation strategy is differencing the average daily nutrient intake of children who participated and did not participate in the school meal program on the reference day in program implementing and non-implementing GPs. This strategy would remove any time-invariant, unobservable community characteristics which simultaneously influence the implementation of the school meal scheme and the total nutrient consumption of the respondents.[17]

$$C^T_{ijk} = \delta_0 + \delta_1 D^A_j + \delta_2 C^M_{ijk} + \delta_3 \sum_{s=1}^{N} C^M_{iks} + \delta'_4 \boldsymbol{\eta}_j + \eta_k + \mu_{ijk} \tag{3}$$

C^T_{ijk} is the total daily consumption of nutrient *i* by child *j* residing in GP *k* on the reference day, D^A_j is a dummy for school attendance on the reference day, C^M_{ijk} is the amount of nutrient *i* consumed from a school meal by child *j* on the reference day. I take into account multiple children receiving school meals within a family by including the sum of nutrient *i* consumed from the school meal by all 5 to 12 year old siblings *s* of child *j*, $\sum_{s=1}^{N} C^M_{iks}$. $\boldsymbol{\eta}_j$ is a vector of individual, household and village characteristics discussed in the Results section.[18] η_k is a dummy for GP *k*. δ_2 gives an estimate of the effect of a 1 unit nutrient transfer from the meal program on the daily intake of children who were offered school meals on the school day. If δ_2 equals 1 it implies a one-for-one increase in daily nutritional intake of transfer recipients and absence of reallocation of household resources in response to the program. The primary sample for the analyses is restricted to children enrolled in public schools only (including public secondary schools not mandated to serve school meals).[19]

There are two main concerns with this estimation strategy. First, the children who attended school might be systematically different in their individual characteristics from those who did not attend.[20] For instance, suppose children who are ill are less likely to attend school and participate in the program and more likely to consume fewer nutrients in a day. In this case, the program impact would be biased upwards. Following Jacoby (2002), I use the randomness in whether the child's reference day was a school or non-school day in the survey as an instrument for school attendance to addresses the possible endogeneity of school attendance.

The validity of using a dummy for a school day, D^o_j, as an instrument for attendance, however, hinges on the critical assumption that there is no systematic difference in nutrient intake of children between these 2 days.[21] But in agricultural economies, as in the survey region, children usually work on the family farm or perform household chores. For instance, if children work more on non-school days and therefore have higher nutrient requirement and consumption on these days the estimated program effect could be biased downwards. 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. Table 4 shows the summary statistics for hours of household work performed by the sampled children on the randomly assigned school/non-school day. Mean daily hours of chores performed by both sample groups in the data are low and comparable across different types of activities. Work for wages by children was almost absent in the survey area. Second, the non-school days were not festivals, which usually have higher food intake relative to school days, but were either Sundays or a public holiday such as the Republic Day. In an agricultural economy Sundays should not be significantly different from a weekday in terms

[16] Measurement error in the calculation of nutrient intake can influence estimated program effect if biases in the recall survey are systematically related to program participation. In the nutrition literature, under-reporting of food consumption in 24-hour recall surveys is found to be 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. The study of Harrison et al. (2000) 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. Given the checks and balances built into the consumption recall interviews in this survey and the evidence in the literature, I find no reason to suspect a correlation between misreporting of food consumption and program participation status.

[17] In the GP survey information was gathered on when and what type of school meal scheme was implemented in all the villages within a GP. In all except one of the 35 GPs cooked meals were initiated in all public primary schools, within its purview, in the same calendar month.

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

[19] In the analysis the non-enrolled are excluded since their unobservable characteristics might be correlated with daily nutritional intake as well as program participation. 11% of children in the sample are currently not enrolled in a school. 66% of these are between ages 5–6 while the official age for entering grade 1 in primary school in India is 6 years. Thus the most likely reason for non-enrollment is delay.

[20] Self-selection by survey households into the school meal program through physical relocation is not of concern in the analysis. 96.9% of the sampled children were enrolled in a public primary school within their residing village and 97.8% of all children currently enrolled in a public primary school had resided within the same household for all of the previous 12 months.

[21] In rural India there are large seasonal variations in household food security (Behrman and Deolalikar, 1989) as well as the types of food consumed. The advantage of this survey is that both school and non-school days were in the same period with no seasonal variation in food security or type of food items consumed by households.

Table 4
Daily activity recall data for school and non-school day.

Activity	Mean hours per day		
	Non-school day ($N=183$)	School day ($N=747$)	Difference
Cooking	0.17 (0.033)	0.16 (0.015)	0.01 (0.035)
Household cleaning	0.28 (0.031)	0.31 (0.017)	−0.03 (0.038)
Sibling care	0.27 (0.037)	0.23 (0.019)	0.03 (0.043)
Livestock care	0.47 (0.074)	0.36 (0.032)	0.11 (0.074)
Collecting water and firewood	0.48 (0.066)	0.48 (0.021)	0.00 (0.053)

Notes: Standard errors in parentheses.

Table 5
Daily nutrient intake of children not offered school meals on school and non-school days.

Nutrient (unit)	Non-school day ($N=93$)	School day ($N=143$)	Difference
Calories (kcal)	1335.53 (44.347)	1254.45 (32.727)	81.08 (54.087)
Carbohydrates (g)	250.18 (8.366)	240.14 (6.057)	10.04 (10.094)
Protein (g)	40.20 (1.537)	38.11 (1.069)	2.09 (1.814)
Calcium (mg)	171.48 (16.175)	126.68 (9.445)	44.79*** (17.525)
Iron (mg)	14.39 (1.062)	10.541 (0.527)	3.85*** (1.077)

Notes: Standard errors in parentheses. *Significant at 10%, **5% and ***1%. 2 missing observations for school day.

of nutrient requirements since the primary engagement of families is on farms which should vary seasonally rather than daily. Eating outside the house during a holiday (either from a shop or at another household) was rare in this area but was nevertheless specifically asked in the recall survey. Third, each public primary school is located within the boundaries of its village and is a few minutes from the homes of enrolled students. Children typically go home during the school lunch break to have a meal, potentially reducing differences in nutrient intake between the two types of days. Finally, average daily intake of calories, carbohydrates and proteins of children whose schools did not offer a meal on the reference day is not significantly different between these two types of days as shown by the summary statistics in Table 5. The difference in calcium and iron intakes goes against finding an impact of the program.

The second source of concern in measuring program impact in Eq. (3) arises from unobservable variation in individual tastes or preferences which might simultaneously determine the *quantity* of individual intake of nutrients, C^M_{ijk}, from school meals and total individual daily consumption.[22] Since government guidelines were followed in the type of school meal to be served, the choice of MDM did not depend on local community characteristics. Thus, average consumption of nutrient i from the MDM in j's school, interacted with the dummy for a school day ($\bar{C}^M_i * D^o_j$) meets the requirements of a good instrument for individual intake of transfer nutrients on the reference day. Instrumenting also reduces any potential measurement errors in individual nutrient transfers.[23] The transfer nutrient consumed by all 5 to12 year old siblings is also instrumented by interacting the mean of the average nutrient consumed in their schools (0 if all non-enrolled) with the number of 5 to12 year old siblings and a dummy for a school day.

To address any remaining concern that the program effect is identified off variation in the quantity of school nutrients served which could be endogenous to community characteristics, I employ two other instruments for individual transfer intake: a dummy for whether the school was currently offering MDMs (D^F_j) and the month of interview (D^M_j) (both interacted with D^o_j). Children whose randomly chosen interview date fell in February were more likely to have consumed a higher quantity of nutrients due to the exogenous policy change which introduced the new and improved meal program from 1st February, 2004 compared to children interviewed in January.[24] This also addresses the question whether the nutritive content of school meals (one measure of meal quality) impacts the extent of substitution of food within households.

[22] In the empirical model I assume universal take-up of the program which is held up by the data.

[23] The average nutrient intake in a school was computed by averaging the quantity of nutrient consumption by students in each school who ate a school meal on the last school day of the interview week.

[24] Although it is tempting to compare the daily intake of participating siblings on a reference day within households offered and not offered the program, all sampled children in a village (and, therefore, household) were interviewed on the same day. So a comparison of the daily intakes of siblings on a reference day is not viable. However, an individual fixed effects analysis would be a finer test than a within household estimation strategy.

Unfortunately, there are observations for only one village within the jurisdiction of most sampled GPs and the date of interview does not vary within a village because all children of a particular village were interviewed on the same day. As a result, I am unable to instrument for attendance without losing identification in a GP fixed effects specification using the entire sample. But in a random, *restricted* sample of five GPs with observations on at least two villages administered by each GP and with variation in the date of the village survey, I instrument for both the individual (and sibling) nutrient intake and attendance.[25]

The robustness of the results obtained from the community fixed effects model is checked by analyzing the individual panel data.

$$C^T_{ij} = \gamma_0 + \gamma_1 D^A_j + \gamma_2 C^M_{ij} + \gamma_3 \sum_{s=1}^{N} C^M_{is} + D_j + \varepsilon_{ij} \quad (4)$$

In Eq. (4) D_j is a dummy for child j. In this OLS-fixed effects specification I am able to difference out time-invariant, unobservable individual characteristics that could be correlated with the quantity of nutrient consumption from the school meal, school attendance and total daily intake. 250 treated children are compared to a control group of 23 students who were enrolled in private primary schools or public secondary schools which were not mandated to serve cooked meals.γ_1 disentangles the effect of attending school on daily nutrient intake while γ_2 is the effect of attending and consuming a school meal on the school day. Thus, γ_2 is essentially a difference-in-differences estimate of the impact of the program on daily nutrient intakes.

3. Results

3.1. Impact of the school feeding program on total daily nutrient intake

Table 6 reports the estimated coefficient on individual school nutrient intake, δ_2. Each column corresponds to a different nutrient while each row refers to an empirical specification. The reported coefficients, therefore, represent separate regressions. The assumption of exogeneity of the quantity of nutrient intake from school meals and program placement is relaxed progressively. The first four specifications (0 to 3) report the cross-sectional estimates across communities with and without the meal program. Specifications 4 to 6 report the GP fixed effects estimates and the individual fixed effects results are shown in the last row.

The naïve 2SLS estimates which treat only school attendance as endogenous in specification 0 suggest that there is a positive impact of nutrient transfers on daily intakes. Accounting for the endogeneity of the quantity of individual school meal intake as well in specification 1, I use average school nutrient intake as an instrument. The F-statistic on the first stage regressions are sufficiently high and suggest good

[25] In 2 out of the 5 GPs there is variation in school/non-school day across villages. Within all 5 GPs there is variation in the offer of school meal program.

Table 6
Impact of school meal nutrient intake on total individual daily nutrient intake.

Specification	Coefficient on quantity of nutrient intake from school meal					
	Calories	Carbohydrates	Proteins	Calcium	Iron	N
Cross-sectional analysis						
(0) 2SLS	0.63*** (0.180)	0.62*** (0.171)	0.71*** (0.173)	0.83** (0.341)	0.85*** (0.243)	901
(1) 2SLS	0.49*** (0.163)	0.52*** (0.154)	0.58*** (0.157)	0.69 (0.445)	0.96*** (0.232)	898
(2) 2SLS	0.70** (0.272)	0.73*** (0.260)	0.81*** (0.279)	0.55 (0.648)	1.15*** (0.324)	898
(3) 2SLS	0.66** (0.269)	0.75*** (0.251)	0.75*** (0.271)	0.25 (0.603)	0.77* (0.386)	901
Community fixed effects						
(4) OLS	0.73*** (0.193)	0.72*** (0.203)	0.68*** (0.211)	0.11 (0.480)	0.62*** (0.212)	901
(5) 2SLS	0.86** (0.336)	1.01*** (0.299)	0.61* (0.304)	−2.74 (1.663)	−0.58 (0.536)	243
(6) 2SLS	1.12** (0.470)	1.24** (0.425)	1.09* (0.528)	−3.45 (2.638)	0.84 (0.535)	243
Individual fixed effects						
(7) OLS	0.76* (0.405)	0.66 (0.399)	0.62 (0.443)	0.15 (0.671)	0.43 (0.342)	546

Notes: Separate regressions for each nutrient. All the models include a 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, 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 (0)–(6) excludes children enrolled in private schools and the currently non-enrolled and (7) excludes currently non-enrolled only.
(0) School attendance on reference day instrumented by dummy for school day.
(1) 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.
(2) Actual school nutrient consumption instrumented by dummy for MDM offer*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 dummy for MDM offer*number of 5–12 year old siblings*dummy for school day.
(3) 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) 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.
(6) GP fixed effects. Actual school nutrient consumption instrumented by dummy for MDM offer*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 dummy for MDM offer*number of 5–12 year old siblings*dummy for school day.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, **5% and ***1%.

predictive power of the instruments and fit of the model.[26] The coefficient on calorie consumption in specification 1 suggests that a 1 kcal transfer to a child through school meals increases her total daily calorie intake by 0.49 kcal. Looking at the coefficients across the row suggests that a child's daily intake rises by half or more of the transfer for all nutrients (except for calcium whose coefficient is insignificant). Using school meal offer to instrument individual nutrient intake from MDMs in specification 2 again indicates a significant impact on total daily intake of all nutrients except calcium. The estimates obtained from the month of interview as an instrument in specification 3 suggest that children who were interviewed in the second month of the survey and their reference day was a school day have higher daily intake of these nutrients, except calcium, compared to children interviewed in the previous month under the old school meal regime.

The magnitude of the point estimates across specifications 1 to 3 are close, although slightly larger in the last two models (except for iron and calcium), suggesting that the average school nutrient intake instrument is robust to endogeneity concerns discussed in the last section. Overall, the estimates suggest that daily nutrient intake of program participants rises by more than 50% of the nutrient transfers. Note that the impact of the cooked meal program in the cross-sectional analysis is identified off those children interviewed on non-school days whose schools were serving cooked meals as well as students receiving free monthly rations. If this 'take-home' program produces an income effect close to that for households with a cooked school meal recipient, then δ_2 would be biased downwards.

The estimated coefficients for the OLS-GP fixed effects specification in model 4 are remarkably similar to the cross-sectional estimates. The preferred 2SLS-GP fixed effects estimates of program impact in specifications 5 and 6 are comparable to the cross-sectional results, except for iron. This suggests that the unobservable characteristics of program implementing and non-implementing GPs are not significantly different. However, the point estimates of the coefficients on calorie, carbohydrates and protein intake are slightly larger, especially in model 6, than obtained from the cross-sectional analysis.

The coefficients obtained from the individual fixed effects model are close to the estimates for calories in specifications 1 to 5. However, the coefficients are not precisely estimated as indicated by the large standard errors.[27] It is important to mention here 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.[28]

Overall, the analysis suggests that between 49% and 100% of the transfers are reflected in a program participant's total daily intakes. The point estimates for the share of calcium and iron transfers showing up in total daily intakes, however, are lower when I account for endogenous program placement and individual fixed effects. However, the standard errors are the largest for the estimated coefficients on calcium and iron, particularly the former, compared

[26] See Appendix A for details of the first stage regressions for specification 2. *F*-statistic for all 2SLS models described in section 2 across all five nutrients is high and comparable.

[27] Measurement error in school meal nutrient intake may also bias the individual fixed-effects estimates downwards.

[28] When I compare the coefficient on school nutrient intake across all specifications with just the restricted sample used in 2SLS-FE model, the conclusions hold up. See Appendix A for details.

to other nutrients across almost all specifications in Table 6. The results for calcium, therefore, are quite imprecise and examined more closely below.

3.2. Impact of the school feeding program on nutrient substitution between meals

Whether the estimates obtained from the analysis of total daily nutrient consumption show us the true program effect depends on how tenable is the assumption that resources consumed by children are substitutable only within a day. 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 substituting nutrients away from the transfer recipient on non-school days but not on school days. But a school week consists of 6 days, from Monday through Saturday, in the survey region. Parents would be allocating food inefficiently if they were not withdrawing nutrients on these 6 days but only on the non-school day from the child.

Second, a spillover of benefits to non-school days could occur either through a large income effect of the transfer program or due to consumption smoothing biasing the effect of the scheme downwards. However, for the average household in the sample the meal transfer accounts for only between 2% (for the old meal program) and 3% (for the new meal program) of total monthly food expenditure.[29] The 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.

I attempt to address this concern regarding fungibility of food allocation across days in the estimation strategy by disaggregating the total daily nutrient consumption of the child into intake during school and non-school hours and analyzing the effect of consuming nutrients from a school meal on nutrient intake during meals within a day.[30] 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 hours are shown in Table 7.[31] 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 hours than those who don't attend school. However, children who participate in the meal program have higher nutrient intake during school hours as shown by the positive coefficient on quantity of nutrients consumed from the school meal scheme. The coefficient on school meal nutrients is not statistically significantly different from 1 at the 1% significance level (except for protein and iron in specification

[29] Survey data on food expenditure (both market purchases and imputed value of production for self consumption) of the households suggests an average monthly food expenditure of Rs. 1202. The cash value of a school cooked meal includes the market value of wheat (Rs. 0.70 per 100 g) and the expenditure on ingredients. This expenditure per student per school month (20 days) varied between Rs. 19.1 for the old meal program and Rs. 28 under the new meal program.

[30] Nutrient consumption during school hours is the sum of the nutrient consumption at home plus nutrients consumed through a school meal during school hours. Children could come home during the school lunch break since the primary schools, in each sampled village, were within the village premises. Information on the school timings was gathered for each child in the household survey (usually 10 a.m. to 4 p.m. for public primary schools).

[31] The results in Tables 7 and 8 are not strictly comparable with those in Table 6. In Table 6 children enrolled in public secondary schools are included in the sample. These children are excluded from the analysis in Tables 7 and 8 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 hours upwards and after school hours downwards.

Table 7
Impact of school meal nutrient intake on total individual nutrient intake during school hours.

Specification	Calories		Carbohydrates		Proteins		Calcium		Iron		N
	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	Quantity of nutrient from school meal	School attendance	
(5) 2SLS-FE	0.95*** (0.149)	−184.05** (14.859)	0.97*** (0.154)	−33.72*** (2.583)	0.89*** (0.182)	−5.70*** (0.625)	1.02** (0.371)	−44.76*** (7.519)	0.66*** (0.149)	−0.45 (0.333)	237
(6) 2SLS-FE	0.62*** (0.142)	−135.64*** (32.871)	0.68*** (0.154)	−26.22*** (5.725)	0.47*** (0.137)	−3.89*** (1.075)	0.13 (0.506)	−23.25** (8.923)	0.43** (0.188)	−0.65 (0.513)	237
(7) OLS-FE	0.89*** (0.229)	−233.12*** (55.927)	0.85*** (0.214)	−42.61*** (10.119)	0.83*** (0.216)	−6.74*** (1.722)	0.75*** (0.206)	−15.73*** (4.499)	0.68*** (0.209)	−1.32** (0.597)	500

Notes: Separate regressions for each nutrient. The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include a 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, 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.
(5) 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.
(6) GP fixed effects. Actual school nutrient consumption instrumented by dummy for MDM offer*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 dummy for MDM offer*number of 5–12 year old siblings*dummy for school day.
(7) Individual fixed effects.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, ** 5% and ***1%.

Table 8
Impact of school meal nutrient intake on total individual nutrient intake after school hours.

Specification	Calories		Carbohydrates		Proteins		Calcium		Iron		N
	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	Quantity of nutrient from school meal	School attendance	
(5) 2SLS-FE	−0.11 (0.236)	73.52** (31.902)	−0.14 (0.238)	14.71** (5.760)	−0.43* (0.223)	2.64** (1.124)	−1.65*** (0.346)	38.03** (10.572)	−1.56* (0.742)	2.71 (1.900)	237
(6) 2SLS-FE	0.45 (0.374)	−20.93 (50.221)	0.39 (0.380)	−1.07 (8.151)	0.47 (0.411)	−1.15 (1.596)	−0.84 (0.522)	39.88*** (11.373)	0.45 (0.469)	−1.83 (1.341)	237
(7) OLS-FE	−0.06 (0.356)	106.64 (73.777)	−0.13 (0.351)	23.43 (12.082)	−0.17 (0.386)	5.08* (2.561)	−0.39 (0.604)	20.14 (15.729)	−0.33 (0.318)	2.18** (1.056)	500

Notes: Separate regressions for each nutrient. The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include a 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, 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.
(5) 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.
(6) GP fixed effects. Actual school nutrient consumption instrumented by dummy for MDM offer*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 dummy for MDM offer*number of 5–12 year old siblings*dummy for school day.
(7) Individual fixed effects.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, **5% and ***1%.

Table 9
Determinants of intra-household reallocation of resources.

Interaction of quantity of calorie intake from school meal with…	Dependent variables			
	Total individual daily calorie intake		Total individual calorie intake during school hours	
	(1)	(2)	(3)	(4)
Male child	−0.09	−0.18	−0.28	−0.31
	(0.404)	(0.428)	(0.285)	(0.335)
Age	−0.01	0.01	−0.12**	−0.13*
	(0.135)	(0.171)	(0.052)	(0.063)
Household size	0.20***	0.28**	0.03	0.02
	(0.057)	(0.129)	(0.026)	(0.058)
Total calorie consumed by 5–12 year old siblings from school meal	−0.00	−0.00	0.00	−0.00
	(0.001)	(0.001)	(0.000)	(0.001)
Below poverty line household	−0.16	0.17	0.24	0.33
	(0.550)	(0.544)	(0.281)	(0.334)
N	243	243	237	237

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 5 in Table 6. In columns 1 and 3 results are reported for separate regressions for each interaction term. In columns 2 and 4 all the interaction terms are included in the same regression.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, **5% and ***1%.

6) in both the community and individual fixed effects models.[32] This suggests an almost one-for-one increase in nutrient intake of program participants. Since these are the preferred estimates, I conclude that there is virtually no reallocation of nutrients by the families during school hours through a withdrawal of nutrients from home meals. However parents could be withdrawing food at other meal times: before or after school.

Therefore, I estimate next the impact of consuming a meal at school on total nutrient intake after school described in Table 8.[33] The positive coefficients on school attendance in specifications 5 and 7 suggest 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 insignificant in all specifications except for proteins, calcium and iron in model 5.

The findings, as indicated by the community and fixed effects estimates, show that withdrawal of nutrients from program participants during meals at non-school hours as well as school hours on the same day is marginal for all nutrients, including calcium. A priori, if there is no substitution between meals within a day then it is even less likely that there is substitution of nutrients between days.[34] Since I do not find evidence that parents are redistributing nutrients between meals in a single day, it supports my claim that the empirical strategy of comparing intake on school and non-school days provides a true estimate of the program effect.

3.3. Determinants of intra-household resource reallocation

The intra-household resource allocation literature suggests that individual or family characteristics may be important determinants of how the household distributes its resources among its members. In order to assess whether these characteristics have any influence on the magnitude of the school meal transfers that reaches the child, I

[32] See Appendix A on P values of F-tests for the coefficient on the nutrient intake from the school meal being statistically equivalent to 1.
[33] Results are similar for nutrient intake before school but are not reported here.
[34] This result might also imply low inter-temporal elasticity of substitution of nutrient intakes.

interact the coefficient on quantity of individual calorie intake from MDMs with a child's sex, age, household size, total quantity of program nutrient transfers to 5 to 12 year old siblings and a dummy for a below poverty line household (BPL).[35] The results of this analysis are shown in Table 9. The model corresponds to specification 5 in Table 6. 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 hours as the dependent variables.

I do not find significant effects of these characteristics, except household size, on total daily calorie intake as indicated in columns 1 and 2. The coefficient on the interaction of family size with the calorie transfer through the feeding program is positive and significant in both columns 1 and 2. Household size may be correlated with some other characteristic, such as income. This is somewhat supported by the fact that the sign on the coefficient on BPL household changes in column 2. In columns 3 and 4, the analysis for calorie intake during school hours suggests that school meals increase the nutrient intake of younger children by a larger proportion compared to older participants in the primary school age group. However, neither coefficients on household size nor age are significant across all specifications in columns 1 to 4.

A result to take note of is the negative, although insignificant, point estimates on the interaction with a boy dummy across all the models which suggest that parents may be withdrawing fewer resources from a female transfer recipient. Given the well-documented literature on discrimination against females in allocation of nutrients in South Asia (and also the positive point estimate on the main effect of being a boy on daily intakes in the analyses), this finding might imply that parents withdraw fewer nutrients from a recipient who is relatively more undernourished. Further studies may help in determining if school meal programs have some influence on reducing gender disparities in food intakes.

4. Conclusion

Given that children typically have little or no bargaining power in influencing the allocation of family resources, a pertinent question arises as to how beneficial are transfers to a child if they are equivalent to an increase in total household resources. Using individual consumption data on a mandated school feeding program from a rural area of India to answer this question, I find that public transfers to children benefit them substantially. The results show that daily nutrient intake of program participants increases notably by 49% to 100% of the transfers. These point estimates, however, are smaller in magnitude that the effects on daily calorie intake from school meals in Philippines (Jacoby, 2002) and vary across different nutrients. Although in many instances the estimates are not statistically significantly different from 1, particularly in community and child fixed effects models, overall the results suggest that there may not be a one-for-one increase in consumption of all nutrients.

A possible explanation for the substantive program benefits is the ‘labeling effect’ of proposed by Kooreman (2000). The presence of the feeding program may have changed parental preferences by making them aware of the level of nutrient deficiency of their children. It is also possible, as suggested by Jacoby (2002), that the bland school meal is not a perfect substitute for tastier home made meals so parents do not withdraw nutrients from the child during meals at home. However, I do not find evidence in the data of greater redistribution within the family when ‘tastier’ school meals replace the relatively tasteless porridge due to a policy change during the survey (refer to specification 3, Table 6). The preferred explanation is based on anecdotal evidence from this survey which suggests that the quantity of the transfer from the program was too small from the perspective of the average family with almost seven members (including four adults) to lead to resource redistribution within households. Thus the cost of withdrawing nutrients from a transfer receiving child was greater than the potential benefits to the member to whom the nutrients could have been reallocated. Of course, the lack of data on food consumption of program ineligible household members or of goods not subsidized by the transfer makes it difficult to draw a firm conclusion about the channel of impact.

The results of this paper have two implications. First, they inform us on the debate regarding the relative cost and benefits of ‘take-home’ (from which the schools in the survey area were transitioning) and ‘on-site’ school feeding programs. In the case of the ‘on-site’ program evaluated here the potential benefits to the transfer recipient are substantial, indicating almost a one-for-one increase in daily intakes. The scheme is able to improve nutritional intakes at school at very low costs per child per day: 1.44 cents for serving porridge to 3.04 cents for providing bread with vegetables or lentils.[36] The individual fixed effects estimates imply that the gap between the average Recommended Dietary Allowance (RDA) and the actual daily intake of children in the primary school going age group can be reduced by up to 30% for calorie intake, up to 10% for daily iron intake and almost entirely for proteins. Thus, the benefits are larger than from a pure income effect of the take-home program in the survey region which entitled school children to a monthly ration of food grains. Further, on-site programs carry implications for not only improving school enrollments but also *daily* participation through improved attendance (Afridi, 2007; Vermeersch and Kremer, 2005). This is particularly true when the requirement of a minimum monthly attendance rate is not strictly enforced in determining the beneficiaries of take-home rations programs in developing countries (Afridi, 2007). Thus even though the cost of on-site supplementary meal programs may be higher than that of take-home pre-cooked meals or grain rations (Beaton and Ghassemi, 1982), the upshot of this paper is that the benefits of a transfer targeted at a child outweigh the relatively higher costs.

The second implication relates to the existence of a causal relationship between health, labor productivity and income which is now well established in the development literature (Strauss and Thomas, 1998). Research suggests that school-based health interventions can be successful in increasing the cognitive ability of program beneficiaries (Soemantri, 1989; Soemantri et al., 1985).[37] If better learning translates into higher earnings potential, school feeding programs have consequences for intergenerational transfers of poverty especially in a country such as India where concerns of rising income inequalities (Deaton and Dreze, 2002) have accompanied recent rapid economic growth.

[35] The result is similar when I interact the *per capita* program transfer to all 5 to 12 year old household members with individual calorie transfer compared to the interaction in levels reported here.

[36] This includes the market price of wheat, cost of milling wheat, the cost of ingredients including salt and spices and fuel and the cook's salary (at an exchange rate of Rs. 45 = $1). The cost estimates are based on the expenditure guidelines given by the government of MP. Actual expenditures by GPs on conversion of wheat grains into cooked meals were lower on average.

[37] Improvements in learning are more likely if the quality of schooling is not adversely affected due to the school meal program. For instance, in India there are concerns, based on anecdotal evidence, that tight local budget constraints may force teachers to play the role of cooks as well, thereby reducing teaching time.

Appendix A

Table A1
Impact of school meal calorie intake on total individual daily calorie intake (cross-sectional, first stage).

Control variables	Dependent variables		
	(1)	(2)	(3)
	School attendance	Calories from school meal	Total calories consumed by 5–12 year old siblings from school meal
Child's age	0.010** (0.005)	6.880*** (2.144)	3.388 (2.631)
Male child	0.009 (0.028)	14.870 (11.465)	1.315 (14.067)
Number of 0–4 year old males in household	−0.016 (0.018)	−11.286 (7.410)	3.864 (9.092)
Number of 0–4 year old females in household	−0.010 (0.019)	7.557 (7.780)	7.757 (9.546)
Number of 5–14 year old males in household	0.016 (0.018)	−0.578 (7.545)	15.107 (9.257)
Number of 5–14 year old females in household	0.006 (0.016)	8.175 (6.468)	8.456 (7.936)
Number of 15–60 year old males in household	0.027* (0.016)	2.845 (6.568)	8.115 (8.058)
Number of 15–60 year old females in household	0.034** (0.016)	−1.228 (6.621)	−11.051 (8.124)
Number of 60+ year old males in household	0.076* (0.039)	1.937 (15.991)	25.670 (19.621)
Number of 60+ year old females in household	−0.046 (0.034)	4.963 (13.925)	0.820 (17.085)
Log of annual household income	−0.070*** (0.024)	7.572 (9.865)	1.262 (12.104)
ST household head	0.017 (0.027)	15.692 (11.066)	22.411* (13.578)
Arable land ownership (acres)	0.000 (0.002)	−0.519 (0.844)	−0.124 (1.036)
Below poverty line ration card	−0.080*** (0.023)	−12.882 (9.440)	−2.209 (11.583)
Male household head	−0.115 (0.070)	−4.140 (28.875)	29.268 (35.429)
Literate mother	0.041 (0.031)	29.057** (12.737)	9.954 (15.628)
ST population in village (%)	0.001** (0.000)	0.226 (0.201)	−0.242 (0.247)
Distance from all weather roads (km)	−0.013*** (0.003)	−1.363 (1.129)	−0.827 (1.385)
Male GP president	0.029 (0.023)	−16.161* (9.550)	−10.864 (11.718)
Reference day was a school day[a]	0.904*** (0.043)	−22.486 (17.826)	30.832 (21.873)
MDM offer*reference day was a school day[a]	−0.112*** (0.042)	235.056*** (17.312)	46.141** (21.241)
MDM offer*number of 5–12 year old siblings*reference day was a school day[±]	0.010 (0.021)	−33.550*** (8.463)	74.096*** (10.383)
Constant	0.617*** (0.232)	−140.338 (95.231)	−88.011 (116.847)
F-statistic	47.64	19.91	13.73
GP dummy	No	No	No
Adjusted R^2	0.5336	0.3169	0.2380
Observations	898	898	898

Notes: The model corresponds to specification 2 in Table 6. The sample excludes children enrolled in private schools and the currently non-enrolled.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, **5% and ***1%.
[a] Instrumental variable.

Table A2
P values for *F* tests of coefficient of quantity of nutrient intake from school meal equivalent to 1.

Specification	Dependent variable									
	Calories		Carbohydrates		Protein		Calcium		Iron	
	Total daily intake	Total intake during school hours	Total daily intake	Total intake during school hours	Total daily intake	Total intake during school hours	Total daily intake	Total intake during school hours	Total daily intake	Total intake during school hours
(5) 2SLS-FE	0.86* (0.336)	0.95*** (0.149)	1.01*** (0.299)	0.97*** (0.154)	0.61* (0.304)	0.89*** (0.182)	−2.74 (1.663)	1.02** (0.371)	−0.58 (0.536)	0.66*** (0.149)
P value	0.69	0.72	0.97	0.83	0.23	0.57	0.05	0.95	0.01	0.05
(6) 2SLS-FE	1.12** (0.470)	0.62*** (0.142)	1.24** (0.425)	0.68*** (0.154)	1.09* (0.528)	0.47*** (0.137)	−3.45 (2.638)	0.13 (0.506)	0.84 (0.535)	0.43** (0.188)
P value	0.81	0.02	0.59	0.06	0.87	0.00	0.12	0.12	0.76	0.01
(7) OLS-FE	0.76* (0.404)	0.89*** (0.229)	0.66 (0.399)	0.85*** (0.214)	0.62 (0.443)	0.83*** (0.216)	0.15 (0.671)	0.75*** (0.206)	0.43 (0.342)	0.68** (0.209)
P value	0.56	0.65	0.41	0.49	0.41	0.46	0.23	0.24	0.13	0.16

Notes: Separate regressions for each nutrient. The coefficients are reported for the actual amount of nutrient consumed by a child from the school meal. All the models include a 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, 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.
(5) 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.
(6) GP fixed effects. Actual school nutrient consumption instrumented by dummy for MDM offer*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 dummy for MDM offer*number of 5–12 year old siblings*dummy for school day.
(7) Individual fixed effects.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, **5% and ***1%.

Table A3
Impact of school meal nutrient intake on total individual daily calorie intake.

Coefficient on	Cross-sectional analysis			Community fixed effects
	(1)	(2)	(3)	(4)
Quantity of calorie intake from school meal	0.63** (0.231)	0.83*** (0.256)	0.91** (0.322)	0.66* (0.241)
N	243	243	243	243
R^2	0.30	0.30	0.30	0.30

Notes: The sample is restricted to 11 villages, which fall within 5 GPs to show comparability of the coefficient across models. Specification numbers correspond to Table 6. All the models include a 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, 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. Sample excludes children enrolled in private schools and the currently non-enrolled.
(1) 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.
(2) Actual school nutrient consumption instrumented by dummy for MDM offer*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 dummy for MDM offer*number of 5–12 year old siblings*dummy for school day.
(3) 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.
(4) GP fixed effects.
Robust standard errors corrected for clustering on the village in parentheses.
*Significant at 10%, **5% and ***1%.

Consumption survey

The consumption survey was designed under the guidance and training of professional nutritionists at the University of Delhi. The field workers were trained to record the type, the ingredients, the quantity and the consistency of the food items the child consumed from the moment she/he woke up the previous morning to the time she/he went to bed the previous night. For the purpose of measuring individual food intake each field worker was provided with standardized household utensils commonly used in the survey area and with which the respondents could easily identify. These included—3 options each 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 kitchen off the field. The raw ingredients were coded and converted into nutrients using software based on the guidelines provided by the Indian Council of Medical Research.

In the household interview information was gathered from both the mother (or the primary household cook) and the child to maintain accuracy of the 24-hour consumption recall data. This was also aimed at ensuring that there were no systematic biases in recall data between a school and non-school day. On school days the interview was conducted after school hours. For a school day recall specific questions were asked on whether the child attended school, was offered a meal at school and if she/he consumed it. Data on the type, quantity and consistency of school meals were recorded in the household recall interview with the child and also cross-checked in an interview with the MDM cook employed in the child's school. For a non-school (and school) day recall the interviewee was probed specifically for items consumed outside the household, such as a corner shop or at a relative's house.

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