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DOES THE ICDS IMPROVE THE QUANTITY AND QUALITY OF CHILDREN'S DIETS? SOME EVIDENCE FROM RURAL BIHAR

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Does the ICDS improve the quantity and quality of children's diets? Some evidence from rural Bihar

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Abstract:

This study analyses the impact of supplementary nutrition provided through ICDS on intakes of calories, proteins, vitamin A and iron among young children in Bihar. The analysis is based on 24-hour dietary recall data collected for 320 children in four villages in rural Bihar in 2013, and uses matching methods to estimate impact. The results suggest that cooked meals, provided to children in the age-group 3-6 years, increase net intake of food by approximately 135 calories (about a third of the intended transfer), 6 grams of proteins (two-fifths of the intended transfer) and 2 grams of iron (half of the intended transfer), but there is no change in the net intake of vitamin A. There is also no evidence of any reduction in food allocated to these children at home. For children below 3 years of age, who receive take-home rations, there are no improvements in intakes of calories or any nutrients. Since the income elasticity of demand for calories and nutrients have been estimated to be of small magnitude, *ex-ante* there is no reason to expect the implicit ICDS income transfer to lead to substantial changes in intakes. That nonetheless, a significant positive effect is observed for children above 3 years suggests that parents view cooked meals differently than take-home rations, the latter being easier to allocate to other household members than cooked meals provided at the ICDS centre.

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Introduction

Despite a prolonged period of sustained economic growth, India continues to be home to the largest population of undernourished people in the world (SOFI, 2015). Particularly vulnerable to food insecurity are young children, rates of malnutrition among whom remain high, despite improvements over time.

Among the many public interventions in India that seek to improve food security, only one, the Integrated Child Development Scheme (ICDS), is targeted specifically to children under the age of six. The major component of the ICDS[1] is supplementary nutrition (SN) which has the explicit objective to "…bridge the gap between the Recommended Dietary Allowance (RDA) and the Average Daily Intake (ADI) of children…" (http://icds-wcd.nic.in/icds/icds.aspx), by providing 500 calories and 12-15 grams of protein per day to each child. For children between six months and three years, this is done by providing an equivalent amount of take-home rations to the mother once a month. For children between three and six years, cooked meals[2] are provided at the ICDS center, known as the *anganwadi*, six days a week.

Although there is literature evaluating the causal impact of the ICDS on child anthropometric outcomes (see for example Lokshin et al., 2005; Kandpal, 2011; Jain, 2015 and Mittal and Meenakshi, 2015), thus far there has been very little evidence on the extent to which the SN programme improves *food intakes* of young children, or whether its impact is diluted by lower allocations of food provided to the child within the home. This is perhaps in part because obtaining a detailed account of the food consumed by an individual child is difficult and time-consuming.

The increase in food consumed by children who participate in the ICDS may differ from the 500 calories and 12-15 grams of protein mandated by the programme. For instance, parents may be motivated by equity concerns to reallocate food at home away from the beneficiary child towards other children. On the other hand, if parents view food transfers differently from income transfers, the food intake of their child may increase by *more* than what would be expected from an income transfer alone; this increase is referred to as the 'flypaper effect'. For example, Kooreman (2000) argues that child benefit programs have a labelling effect that changes the parental preferences which can translate into higher total intakes among children

[1] There are in all six components of the ICDS: supplementary nutrition, immunization, health check-ups, growth monitoring, preschool education and nutrition education to their mothers. This paper, however, focuses only on supplementary nutrition.

[2] Both take-home rations and cooked meals are equivalent in monetary terms and translate into a transfer of approximately Rs. 104 to each beneficiary household, or about 3 percent of average monthly household food expenditure.

than with an income transfer alone. But even here, the increase in actual food intakes may fall short of the magnitude of the intended transfer.

This provides the context for this paper, which attempts to provide *causal* estimates of impact of the ICDS on both the quantity (calories) and quality (protein, iron and Vitamin A) of food consumed by pre-school children. Iron and vitamin A deficiencies are widespread both globally and in India: insufficient intakes of iron may lead to impaired physical and cognitive development (WHO 2001) while Vitamin A deficiency is responsible for preventable blindness among children, and is implicated in morbidity (related to measles for example) as well as higher mortality.[3]

Further, since the mode of transfer varies by age group, with younger children receiving take-home rations and older children being provided meals at the ICDS center, the paper estimates impact disaggregated by age group to see if the magnitudes vary for transfers that are take-home in nature versus those that are provided as cooked meals.[4]

As noted above, there is little evidence on this question for India. An early paper is by Beaton and Ghassemi (1982) who review the impact of participation in 8 pre-school food supplementation programs on food intake of children, of which 5 provided take-home rations and 3 provided on-site cooked meals. They conclude that only 40-60 percent of the calories provided through the programs actually reaches the child and that there is not much difference by the mode of delivery. They review two programs, Project Poshak and a program in Tamil Nadu, both of which were implemented in the 1970s and provided take-home rations and on-site cooked meals and find that the absolute increase in calorie intake of children as a consequence of participation did not differ (ranged between 66 and 130 calories per child), across the two programs or by the mode of delivery. The increase in the total calorie intake of the child ranged between 66-130 calories per day. Vaid and Vaid (2005) measure the food intake of 15 ICDS participants and non-participants and find that participants have higher intakes of calories, proteins, fats and iron, but this is based on a relatively small sample and on a simple comparison of averages. Afridi (2010) looks at older (school-going) children and finds that the mid-day meal program for school-going children in India reduced the prevalence of calorie deficiency by nearly 30 percent and protein deficiency by 100 percent. Also, she finds that increased intakes of calories and proteins constituted at least 50 and 60 percent of the intended transfer, respectively.[5]

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[3] World Health Organization. Nutrition: Micronutrient deficiencies. http://www.who.int/nutrition/topics/vad/en/, accessed on 14th June, 2016.

[4] In Bihar, take-home rations consist of two kilograms of rice and one kilogram of pulses every month. The menu for hot cooked meals consists of *khichdi* (a dish made of rice, pulses and vegetables), *pulao* (a dish made of rice, vegetables and groundnut), *halwa* (a sweet dish made using wheat flour, gram flour and jaggery) and *kheer* (a sweet dish made of rice, jaggery and groundnuts). *Khichdi* was served thrice a week, while all other dishes were served once a week.

[5]For countries other than India, the literature largely pertains to school-going children, and examines whether interventions succeed in transferring the entire amount of the intended transfer to the target population. This literature also makes a distinction between whether the transfers from targeted programmes are higher than what would be expected from an equivalent income transfer alone. For instance, while Jacoby et al. (1996) find that the energy intake of children participating in a school breakfast program in Peru increased by 50 percent of the

This paper thus attempts to contribute to the literature by providing more recent, and causal evidence of impact of the program on food intakes of preschool children. A second contribution of this paper is that it extends the analysis to consider the quality of food. Apart from examining impact on calories and protein intakes, it examines if the ICDS has had an impact on two key micronutrients: iron and vitamin A. Although not explicitly the focus of the ICDS, deficiencies in micronutrients intakes, often referred to as "hidden hunger" are also implicated in adverse nutritional outcomes. A focus on quantity-quality distinctions is also merited given the stylized fact that at the household level, calorie-income elasticities are extremely low (Deaton and Dreze, 2009), suggesting that income effects may be more visible in quality changes (see for example Jha et al., 2009).

The analysis is based on a primary survey of 320 children aged one to six years, conducted in four villages in Bihar, one of India's poorer states. A unique feature is that the survey canvassed child-specific food intakes, using the 24-hour dietary recall method proposed by Gibson and Ferguson (2008), and collected detailed information on household recipes that were used to compute nutrient intakes.

The sampling strategy, method of estimation of food intakes, and summary statistics are set out in section 2, while section 3 sets out the matching methods used to estimate impact, disaggregated by mode of transfer. Section 4 discusses results, which suggest that the SN program has a smaller impact of quantity as compared to quality, and that impact differs by the mode of delivery of the program. Section 5 provides conclusions.

2. Sampling design, Estimation of Food Intakes and Summary statistics

2.1. Sampling design

The analysis is based on a primary survey conducted from February to April 2013 in four villages in Bihar. These four villages are part of the Village Dynamics of South Asia sample of the International Crops Research Institute for the Semi-Arid Tropics (see Mittal and Meenakshi, 2015 for details). In each village, the sampling frame comprised of households with children in the target age-group of 1-6 years. These households were then stratified into four land class categories – landless (owning less than 0.005 acres of land), small (holding land size between 0.005 to 0.5 acres), medium (between 0.5 to 1.5 acres) and large (1.5 acres and

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intended transfer, other studies find a higher impact. Studies by Ahmed (2004) for the US, Murphy et al. (2003) for Kenya and Jacoby (2002) for Philippines find that 50-100 percent of the intended transfer sticks with the beneficiary child. However, results of Bhattacharya et al. (2006) are contrary to all other studies. Evaluating the school breakfast program in the US, they do not find any impact of participation in the program on calorie intake of school going children. Adelman et al. (2007) conclude that the differences in the magnitude of impact across countries could be due to differences in the level of calorie intake before program was implemented. Food supplementation programs have a higher potential of increasing the total calorie intake in countries which have low level of food consumption.

above) land owners. Sampling with probability proportional to size was used in each stratum: in each of the four villages 30, 25, 12 and 13 households were randomly selected from the landless, small, medium and large land owning categories, respectively. Thus, a total of 320 households, 80 in each village, were surveyed for this study. A reference child was then randomly selected from eligible children within each household. Among them, there were 215 children aged above 33 months who received cooked meals,[6] and 105 younger children whose mothers received take-home rations.[7]

2.2. Estimating energy and nutrient intakes for young children

The survey questionnaire consisted of several modules, including one on household-specific socio-economic characteristics, and another on care-giver (mother)-specific information on her nutritional knowledge, education levels and so on. The unique aspect of the data collection, however, was the estimation of food intakes of each reference child, based on a multiple-pass, 24-hour recall based methodology detailed in Gibson and Ferguson (2008), considered the gold standard for determining calorie and nutrient intakes. The portion sizes consumed by the child were estimated using various techniques, such as volume of food, clay replicas, which rely on visualization of the portion size consumed. The multiple passes, aided by picture charts and detailed probing, ensure that none of the food items consumed are missed by the respondent. These estimates were then converted into actual quantities of food items consumed using the conversion factors that were collected during the survey.

The quantities of food consumed at home were converted into energy, protein and micronutrient intakes, using local recipes and the food composition tables provided by the Gopalan et al. 1980, the Bangladesh Food Composition table and nutrition information printed on packaged food. In addition, a set of adjustments to account for (a) snacks and meals consumed outside home and (b) cooked meals consumed at ICDS center (only for children above 3) was also made.

The first adjustment affects twelve of the sampled children, who reported consuming a meal or a snack outside home (apart from cooked meal provided at ICDS). Since it was not possible to quantify the types of dishes consumed outside, their caloric intakes were adjusted by 403 calories per meal, an estimate of calorie content of meals consumed outside the home (using NSS data) provided by Tandon and Landes (2011). Every snack is assumed to consist of one-fourth of the calories of the meal. Tandon and Landes (2011) do not provide similar estimates for protein, vitamin A and iron; these intake figures therefore remain unadjusted. To the extent that meals and snacks consumed outside the home are more likely to be dense in fats

[6] The sampling strategy was to pick from each sampled household one pre-school child; the further disaggregation into children above 3 years and those younger was done subsequently. Note however that (as expected) the distribution of households with children above 3 years of age, across size of land holding is similar in both the census and sample. This is also true of households with children below 3 years of age.

[7] A sample size of 100 children (spread over two groups) would have been powered to detect a difference of 250 calories, 6.8 grams of protein and 1.9 mg of iron, but perhaps not of vitamin A, based on a first difference in means and assuming a 5 percent probability of type I error and 20 percent probability of type II error. These magnitudes represent half of the nutrient content of the ICDS meals, and was chosen to allow for the possibility of substitution from food provided at home.

and sugars, an adjustment for calories is likely more important than that for other nutrients. As a robustness check, in a variant, estimates presented in Section 4 assume that each full (non-ICDS) meal consumed by a child outside the home contains 218 calories, the lower bound of the confidence interval around the estimated 403 calories.[8]

The second adjustment relates to the energy and nutrient content of the ICDS meal. This in turn is based on two different assumptions: first they are based on estimates provided by Fraker et al. (2013) who conducted laboratory tests of the energy and protein content of a sample of ICDS meals in Bihar. They find that on average, the ICDS meal provides 386 calories and 11.7 grams of protein. To cross-check, the schedule of meals and weekly menu, which also specifies the quantity of each ingredient (per child) to be used in cooking was used to compute the nutrient content of each dish. An average (per day per child) was then calculated over the week, weighted by the number of days each dish is served, and adjusting for portion sizes observed on a typical day.[9] The magnitudes across the two methods match closely; thus the actual average transfer is about 78 percent of the intended transfer. Under the second assumption, the magnitude of the intended transfer is used, consisting of 500 calories and 13.5 grams of protein.

Since there are no mandated norms for the micronutrients, the iron and vitamin A contents of the ICDS meal were computed from the recipes as detailed above.[10] A similar 78 percent was then taken as the actual content: 250 mcg of vitamin A and 2.9 mg of iron.[11] A sum of calories and nutrient intakes from food allocated at home and from the ICDS meal provides an estimate of total calorie and nutrient intakes of a 3-6 year old child. For younger children, only food consumed at home is relevant.

Whether actual or intended transfers are used to compute the content of ICDS meals, all children identified as having consumed an ICDS meal on the day of the survey are assumed to have received the same quantity of calories and nutrients from the meal. The assumption is that the portion sizes for all children who eat at the ICDS center are equal irrespective of age. Although in principle it is possible that on the day of the survey a given child left food on the plate, it cannot be verified. Note that this is not the same as adjusting the caloric intake of all participating children by this amount, as on the day of the survey a participating child may not actually have eaten at the center (because the survey day may have coincided with the center's weekly off-day or for other reasons).

[8] Further since this affects only 12 children, all references to calories/nutrients consumed from food allocated at home includes meals consumed outside the home in this fashion.

[9] The imputed calorie and protein content of the meals as computed from the recipes provided does coincide with the calorie and protein norms.

[10] Two of the dishes on the menu, *khichdi* and *pulao*, are supposed to include seasonal vegetables, the choice of which is at the discretion of the ICDS worker. An average of vitamin A and iron content of vegetables that were available during the time of survey were used to determine content.

[11] There was no fortification of these meals with micronutrients in Bihar (unlike some other states). The anganwadi workers were provided money to buy supplies for the cooked meal and take home rations from the open market.

2.3. Summary Statistics

Summary statistics are presented separately for total nutrient intakes, for the entire sample and for the two sub-samples of children aged three to six years (212 observations) and those aged one to three years (102 observations).[12] Of the entire sample, 145 children (approximately 45 percent) had received supplementary nutrition from the anganwadi center; similar participation rates also obtain among the two sub-samples of children aged 6 months to three years who received take-home rations, and of three to six years who got cooked meals at the *anganwadi*.

Data for total intakes and from food consumed at home for the full sample and each of the two sub-sample of children are presented in Table 1. Since the younger children get take-home rations and do not eat any meals at the ICDS center, no adjustments are necessary; the total and at-home intakes coincide.

These comparisons suggest that caloric intake from food at home for ICDS participants was significantly lower for the full sample, as well as the two sub-samples. This was also true of protein intakes. Total energy and protein intakes were, however, no different across participants and non-participants for the full sample and were slightly higher for participants who received cooked meals, suggesting that there may have been some substitution of food provided at home for these children. To put these numbers in perspective, based on actual (rather than intended intakes) the percentage of children 3-6 years who had inadequate intakes of calories was 37 percent for those who received SN, and 48 percent of those who did not. For younger children, 56 percent of participants and 39 percent of non-participants had intakes that were lower than the requirements. For protein, 9 percent of 3-6 year olds and 44 percent of the 1-3 year olds ICDS participants had inadequate intakes; the percentages in both cases being higher for non-participants.

Particularly inadequate are the intakes of micronutrients. For instance, nearly all the sampled children had inadequate intakes of vitamin A, and there were no differences in intakes across participants and non-participants for both age groups. With iron, the prevalence of inadequate intakes was nearly as high, at between 80 to 83 percent.

Participants and non-participants differ in other ways as well, for the overall sample as well as the two sub-samples. Participants are less likely to belong to "other" caste category households and more likely to belong to the same caste as the ICDS worker, suggesting that social access costs matter. Also, participants lived closer to the ICDS center (but by a difference that is not economically meaningful), were more likely to have used ICDS services previously, belonged to poorer households. [13] Participants and non-participants

[12] We had to drop 3 observations for each of the sub-sample because we use characteristics of both parents to match SN participants with non-participants in our estimation and these children only had one parent alive.

[13] The index for assets owned was constructed using information on ownership of assets such as farm implements, livestock and consumer durables through Principal Component analysis (PCA).

Table 1: Summary statistics, disaggregated by age group

Variables	Full sample			Children 3-6 years			Children 1-3 years		
	SN participants	Non participants	Difference	SN participants	Non participants	Difference	SN participants	Non participants	Difference
A. Energy and nutrient intakes of reference child									
Total energy intakes,	1239	1,223	16	1,372	1,273	99*			
actual (kcal/day)	(36.35)	(30.62)	(47.53)	(40.64)	(39.01)	(56.33)			
Total energy intakes,	1,285	1,223	62	1440	1,273	167***			
intended (kcal/day)	(38.57)	(30.62)	(49.25)	(42.67)	(39.01)	(57.81)			
Energy intakes at	1,085	1,223	-138***	1,141	1,273	-132**	972	1,116	-144 **
home (kcal/day)	(32.86)	(30.62)	(44.91)	(39.54)	(39.01)	(55.54)	(55.96)	(44.87)	(71.73)
Total protein intakes,	28.9	27.6	1.3	33.9	29.7	4.2***			
actual (grams/day)	(1.11)	(0.90)	(1.42)	(1.16)	(1.09)	(1.60)			
Total protein intakes,	29.6	27.6	2.0	35.0	29.6	5.4***			
intended (grams /day)	(1.15)	(0.90)	(1.46)	(1.20)	(1.09)	(1.62)			
Protein intakes at	24.2	27.6	-3.4***	26.9	29.6	-2.7*	18.6	23.2	-4.6**
home (grams /day)	(0.92)	(0.90)	(1.29)	(1.05)	(1.09)	(1.51)	(1.55)	(1.42)	(2.10)
Total iron intakes,	7.8	7.4	0.4	9.4	8.0	1.4**			
actual (mcg/day)	(0.41)	(0.38)	(0.56)	(0.45)	(0.46)	(0.64)			
Total iron intakes,	8.2	7.4	0.8	10.0	8.0	2***			
intended (mcg/day)	(0.43)	(0.38)	(0.57)	(0.47)	(0.46)	(0.65)			
Iron intakes at	6.7	7.4	-0.7	7.7	8.0	-0.3	4.6	6.2	-1.6*
home (mcg/day)	(0.37)	(0.38)	(0.53)	(0.43)	(0.46)	(0.63)	(0.61)	(0.65)	(0.89)
Total vitamin A intakes,	617	614	3	696	685	11			
actual (mcg/day)	(116.01)	(142.38)	(183.66)	(154.76)	(200.92)	(253.62)			
Total vitamin A intakes,	647	614	33	741	685	56			
intended (mcg/day)	(116.12)	(142.38)	(183.73)	(154.69)	(200.92)	(253.58)			
Vitamin A intakes at	517	614	-97	546	685	-139	458	463	-5
home (mcg/day)	(116.22)	(142.38)	(183.79)	(155.65)	(200.92)	(254.16)	(157.79)	(124.64)	(201.08)

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: † - an index for number of assets owned constructed using PCA. †† - an index for knowledge constructed using PCA. ††† - an index for mother's bargaining power constructed using PCA.

Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

Table 1 (Continued): Summary statistics, disaggregated by age group

Variables	Full sample (n=314)			Children 3-6 years (n=212)			Children 1-3 years (n=102)		
	SN participants	Non participants	Difference	SN participants	Non participants	Difference	SN participants	Non participants	Difference
B. Child and Parental Characteristics									
Age of the child	42	45	-3	50	54	-4**	24	23	1
(months)	(1.28)	(1.41)	(1.91)	(1.05)	(1.24)	(1.63)	(0.93)	(0.88)	(1.28)
Mother's nutritional	1.15	1.43	-0.28***	1.10	1.42	-0.32***	1.26	1.47	-0.21
knowledge index††	(0.05)	(0.05)	(0.07)	(0.06)	(0.06)	(0.09)	(0.09)	(0.10)	(0.13)
Mother's bargaining	-4.61	-4.02	-0.59*	-4.36	-3.90	-0.46*	-5.11	-4.28	-0.83
power index†††	(0.25)	(0.16)	(0.30)	(0.21)	(0.16)	(0.26)	(0.63)	(0.36)	(0.73)
Father's age (years)	34	33	1	34	34	0	32	29	3*
	(0.62)	(0.51)	(0.80)	(0.71)	(0.62)	(0.94)	(1.17)	(0.78)	(1.41)
Working mother (%)	19	16	3	20	18	2	17	13	4
	(3.24)	(2.83)	(4.30)	(4.05)	(3.55)	(5.39)	(5.44)	(4.61)	(7.13)
C. Household Characteristics									
Time taken to reach ICDS	13	16	-3***	13	17	-4**	13	15	-2
center (minutes)	(0.77)	(0.86)	(1.15)	(0.95)	(1.00)	(1.38)	(1.32)	(1.66)	(2.12)
Belong to the same caste as	71	55	16***	73	57	16***	67	50	17*
ICDS worker (dummy)	(3.78)	(3.84)	(5.39)	(4.52)	(4.63)	(6.47)	(6.88)	(6.87)	(9.72)
Used ICDS 3 months prior	85	59	26***	87	56	31***	81	65	16*
the survey (dummy)	(2.99)	(3.80)	(4.84)	(3.48)	(4.65)	(5.81)	(5.69)	(6.56)	(8.69)
Assets owned†	0.59	0.86	-0.27***	0.54	0.78	-0.24***	0.69	1.03	-0.34*
	(0.05)	(0.06)	(0.08)	(0.05)	(0.08)	(0.09)	(0.10)	(0.12)	(0.16)
Scheduled caste (%)	32	19	13***	29	23	6	40	13	27***
	(3.90)	(3.06)	(4.96)	(4.62)	(3.92)	(6.06)	(7.13)	(4.61)	(8.50)
Backward caste (%)	59	59	0	60	55	5	56	67	-11
	(4.10)	(3.80)	(5.59)	(5.00)	(4.66)	(6.84)	(7.24)	(6.48)	(9.71)
Other caste (%)	9	22	-13***	11	22	-11**	4	20	-16**
	(2.38)	(3.19)	(3.98)	(3.24)	(3.92)	(5.08)	(2.91)	(5.53)	(6.25)
Number of Observations	145	169		97	115		48	54	

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: † - an index for number of assets owned constructed using PCA. †† - an index for knowledge constructed using PCA. ††† - an index for mother's bargaining power constructed using PCA.

Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

also differed in the degree to which mothers had bargaining power[14] within the household, and had nutritional knowledge. [15] No other characteristics were significantly different among the two groups.[16]

These systematic differences in average characteristics between participants and non-participants suggests that it is necessary to account for them in constructing a counter-factual that is comparable to participants to estimate impact of the ICDS. Matching methods discussed below help achieve this.

3. Empirical Strategy

The impact of participation in the SN program is the difference in the food intakes of participants and *comparable* non-participants. Given that participation in the ICDS is voluntary, it is necessary to account for selection into the programme. The summary statistics above suggest that the two groups cannot be treated as if they were randomly allocated to participation status; and therefore a comparison of raw differences in mean outcomes will give biased estimates of impact.

Under the maintained assumption that the factors that determine programme participation are observed, matching techniques can be used to create the appropriate counterfactual. This is the approach used by nearly all studies examining the impact of the ICDS on anthropometric outcomes, including Jain (2015), Kandpal (2011) and Mittal and Meenakshi (2015). Matching methods match participants with non-participants who are similar on these observed characteristics. Let, D be an indicator variable representing participation in the program, where a value of 1 represents participation and 0 represents non-participation, and F^1 and F^0 be the outcome (in this case, intake of calories, protein, vitamin A and iron) of participants and non-participants, respectively. Let Z denote the vector of observed variables which determine participation, the average treatment effects on the treated (ATT) can be computed as (Rubin, 1977; Rosenbaum and Rubin, 1983):

$$ATT = E(F^1|Z, D = 1) - E(F^0|Z, D = 0)$$

The main assumption that underlies the identification of impact estimated this way is that outcomes of participant and non-participants are orthogonal to treatment assignment, after controlling for observable factors in Z, that is, $F^1, F^0 \coprod D|Z$. This also implies that outcomes are orthogonal to treatment assignment conditional on some specific function of Z (such as

[14] The difference in the age of parents and mother's rank (in terms of her status) in the household, both of which are exogenous, to create an index of *mother's bargaining power* using PCA.
[15] Several questions were asked to elicit *mother's nutritional knowledge*. These included questions about awareness of vitamin A, iodine and treatment of diarrhoea. All these variables were combined using PCA to create an index of nutritional knowledge.
[16] Several other variables were examined, including: differences in the proportion of male children among surveyed children, birth order of the child, health endowment of the child, number of siblings, parents' age, their literacy status, child care practices adopted, time spent in child care, presence of alternative caregiver, proportion of households with non-migrant father, household size, and land ownership. None of these variables was significantly different across participation status.

propensity score): that is, $F^1, F^0 \coprod D|P(Z)$, following Rosenbaum and Rubin, (1983). In other words, there are no *unobservable* characteristics that influence both outcomes (calories and other nutrients) and SN programme participation.

For the entire sample, as well as each of the subsamples based on two age groups (modes of transfer), two methods are used: propensity score matching (Rosenbaum and Rubin, 1983) and covariate matching (Abadie and Imbens, 2002). Both produce unbiased estimates of impact provided the orthogonality condition above is met, but differ in the way the metric that is used to match the participants with non-participants (achieve balancing) is generated. While propensity score matching technique uses propensity scores (probability of participating in the SN program), covariate matching method uses the Euclidean distance between the observable characteristics. In both cases, however, the focus here is only on the sample average treatment effect on the treated.

Within propensity score matching, there are several methods that are used to create counterfactual. These methods essentially differ in the way weights are assigned to non-participants while matching them with participants. This study uses two of the methods as a check of robustness of the results. First is nearest neighbour matching, which matches a treatment observation to the n closest neighbours (in terms of propensity score) and gives equal weight to all n neighbours (5 neighbours in this estimation). The analytical standard errors proposed by Abadie and Imbens (2006) are used for this method. The second method is kernel matching, which unlike nearest neighbour matching, uses a weighted average of all observations in the control group to construct the counterfactual. The weights assigned to each control observation depend on the distance to treatment observations for which the counterfactual is being created; a closer observation is assigned higher weights. While it is difficult to derive the large sample distribution of estimator for nearest neighbour matching, as these estimators are highly non-smooth functions of the distribution, the asymptotic distribution for the kernel matching was provided by Heckman, Ichimura and Todd (1998).

Following related literature (Lokshin et al., 2005; Kandpal, 2011; Jain, 2015 and Mittal and Meenakshi, 2015) the set of potential covariates Z that enter the matching equation include (a) the economic costs of accessing the ICDS center, as determined by the time taken to visit the ICDS center, the mother's participation in the labour force (b) social access costs, (c) child's characteristics such as age, gender, birth order, size at birth, whether child fell ill in past one month, number of siblings and dummy for using ICDS before, (d) mother's characteristics (age, literacy status, nutritional knowledge, bargaining power, child care practices followed), (e) father's characteristics (age, literacy status, dummy for non-migrant fathers) and (f) household-specific characteristics (number of alternative caregivers, household size, access to hygienic sanitation facility and economic status). The final set of covariates varies somewhat by subsample (depending on the age group) was determined based on which yielded the best balance (in terms of insignificant differences in averages of various covariates across participant and matched non-participants).

4. Impact of the ICDS on Energy and Nutrient Intakes

Impact estimates are computed using the three different matching methods as outlined in Section 3.

The outcomes include intakes of energy, protein, Vitamin A and iron; and estimates are presented separately for total intake and intake from food consumed at home. At-home and total intakes differ only for children 3-6 years old; the younger children get take-home dry rations and do not consume meals at the *anganwadi* center. There are two sets of estimates for total intakes, one corresponding to the actual transfer (based on the estimates by Fraker et al. (2013), and one corresponding to the intended transfer. The former may be interpreted as an estimate of impact as implemented, while the latter represents the magnitude of the potential impact from the ICDS.

Note that since not all beneficiaries may have consumed a meal at the ICDS center on the day of the survey (which included Sundays), the distribution of total calorie (nutrient) intake is not merely a mean-shift of the distribution of calorie (nutrient) intake from food allocated at home (shifted to the right by the amount of the intended transfer). Among all SN participants, only 60 percent consumed an ICDS meal on the day of the survey.[17] Therefore, the adjustment for calories and nutrients provided by the ICDS meal is made for only those children who actually consumed an ICDS meal on the day of the survey.[18]

In all cases, only those estimates that are significant (at least at the 10 percent level) across at least two of the three matching methods are interpreted. In other words, if for a given outcome, only one of the matching estimates of impact is significant, this is not deemed as evidence of impact.

4.1 Estimated Impact, full sample

For the full sample (Table 2), it would appear that there is no evidence of a difference in (actual) total energy intakes, between participants and non-participants, as all the matched differences are insignificant. This is also true when the magnitudes of the intended transfers are used to compute total intakes (only one of impact estimates is significant). Note however, that this does not imply that the ICDS has had no impact, since ICDS beneficiaries consumed between 105 and 122 calories less than non-beneficiaries from food consumed at home. This indicates that there was some substitution between food received at the *anganwadi,* and food provided at home, in the aggregate, although it is not seen in any of age-specific sub-samples.

In the case of protein, ICDS participants have between 2 and 3.5 grams per day higher intakes than non-beneficiaries, depending on which of the two methods used to derive total intakes is used, while there is no difference in the amount of protein consumed at home: the

[17] Out of these 39 children, for 11 children, the day of the survey was Sunday and therefore ICDS meal was not available. We do not know the reason why other children did not consume the ICDS meal on the day of the survey.

[18] This is consistent with a Program Evaluation Organization (PEO) of the Planning Commission (PEO 2011) report that in Bihar, ICDS meals are served on only 14 days of the 26 working days in a month (approximately 55 percent).

ICDS has had an impact on improving this aspect of diet quality; this translates into between 12 and 21 percent of the average requirements for pre-school children. The ICDS does not also seem to have increased iron intakes, unless intended transfers are considered; in other words the ICDS has the potential to increase intakes of iron of nearly 1 mg per day), and there is no apparent substitution from foods consumed at home. For Vitamin A, however, none of the differences in intakes—whether total or at-home—are significant.

Table 2: Impact of ICDS on energy and nutrient intakes, full sample

Outcomes	Unmatched differences	Nearest Neighbour Matching	Covariate Matching	Kernel Matching
	Calories (kcal per day per child)			
Actual intake	167	49	32	49
(home + actual transfer)	(47.18)	(45.40)	(50.42)	(65.02)
Intended transfer	62	95**	78	94
(home + intended transfer)	(48.67)	(46.84)	(51.91)	(66.31)
At home	-138***	-105**	-122**	-105*
Consumption	(44.91)	(43.33)	(47.52)	(63.09)
	Proteins (grams per day per child)			
Actual intake	1.3	2.1*	2.8*	2.4
(home + actual transfer)	(1.41)	(1.20)	(1.48)	(1.92)
Intended transfer	2.0	2.8**	3.5**	3.1
(home + intended transfer)	(1.44)	(1.23)	(1.50)	(1.95)
At home	-3.4***	-2.6**	-1.9	-2.3
Consumption	(1.29)	(1.10)	(1.38)	(1.82)
	Iron (mg per day per child)			
Actual intake	0.4	0.8	0.9*	0.9
(home + actual transfer)	(0.56)	(0.52)	(0.52)	(0.78)
Intended transfer	0.8	1.2**	1.2**	1.3
(home + intended transfer)	(0.57)	(0.53)	(0.53)	(0.79)
At home	-0.8	-0.4	-0.3	-0.2
Consumption	(0.53)	(0.50)	(0.50)	(0.76)
	Vitamin A (mcg per day per child)			
Actual intake	3	151	320	193
(home + actual transfer)	(187.56)	(149.98)	(210.98)	(275.63)
Intended transfer	33	181	350*	222
(home + intended transfer)	(187.62)	(150.14)	(210.91)	(275.68)
At home	-97	51	220	93
Consumption	(187.67)	(149.81)	(211.44)	(275.72)

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: Actual intake is a sum of intake at home and that provided through ICDS meal. Intended transfer is a sum of intake at home and the number of nutrients ICDS program intends to transfer to the child. Sample size is 314. Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

4.2 Estimated impact, children 3-6 years

A shaper picture emerges when impact estimates are disaggregated by age-group or mode of transfer (Table 3). Children aged 3 years or older, who obtain one meal at the ICDS center, have energy intakes that are 117 to 160 calories higher than those who don't, when the actual nutrient content is used, and between 185 to 230 calories higher, when the intended magnitude of transfer is used. Neither is there any evidence of substitution of food at home (only one of the matching methods is indicative of such a substitution).

Table 3: Impact of ICDS on energy and nutrient intakes, children 3 to 6 years receiving cooked meals at the *anganwadi* center

Outcomes	Unmatched differences	Nearest Neighbour Matching	Covariate Matching	Kernel Matching
	Calories (kcal per day per child)			
Actual intake	99*	132**	117*	162*
(home + actual transfer)	(56.54)	(62.64)	(63.76)	(85.90)
Intended transfer	167 ***	200***	185***	230***
(home + intended transfer)	(57.79)	(64.06)	(64.85)	(86.87)
At home	-132**	-99	-113*	-69
Consumption	(55.88)	(60.96)	(62.29)	(85.38)
	Proteins (grams per day per child)			
Actual intake	4.3***	5.9***	5. 6***	6.7***
(home + actual transfer)	(1.59)	(1.52)	(1.70)	(2.41)
Intended transfer	5.4***	7.0***	6.6***	7.8***
(home + intended transfer)	(1.62)	(1.54)	(1.72)	(2.43)
At home	-2.7*	-1.1	-1.44	-0.27
Consumption	(1.53)	(1.48)	(1.63)	(2.37)
	Iron (mg per day per child)			
Actual intake	1.4**	2.0***	1.9***	2.5**
(home + actual transfer)	(0.65)	(0.54)	(0.64)	(0.99)
Intended transfer	2.0***	2.6***	2.4***	3.0***
(home + intended transfer)	(0.66)	(0.55)	(0.64)	(1.00)
At home	-0.3	0.3	0.1	0.8
Consumption	(0.63)	(0.52)	(0.62)	(0.98)
	Vitamin A (mcg per day per child)			
Actual intake	11	258	247	297
(home + actual transfer)	(260.93)	(169.84)	(247.13)	(419.39)
Intended transfer	56	303*	292	342
(home + intended transfer)	(260.89)	(169.69)	(246.68)	(419.36)
At home	-139	108	97	147
Consumption	(261.37)	(170.84)	(248.87)	(419.72)

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013
Notes: Actual intake is a sum of intake at home and that provided through ICDS meal. Intended transfer is a sum of intake at home and the number of nutrients ICDS program intends to transfer to the child. Sample size is 212. Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

Similarly, total protein intakes for ICDS beneficiaries in this age group are higher by between 5.6 to 6.7 grams when the actual magnitude of average transfer is considered, and by between 6.6 to 7.8 grams when the intended magnitude of transfer is used to compute total intakes. These figures represent 33 to 39 % and 39 to 46% of average requirements of children in this age group respectively. There is however no difference in protein intake from food consumed at home between the two groups of children. Similarly, there is evidence that even at the lower-than-mandated levels of food provided by the *anganwadi* center, total iron intakes increased by between 1.9 to 2.5 mg per day, providing 16-21 percent of average requirements. There was no substitution evident in iron intakes from food consumed at home, with insignificant differences between participants and non-participants across all three matching methods. For vitamin A, however, there is no evidence of impact.

4.3. Estimated impact, children 1-3 years old

Younger children are given take-home rations and therefore it is not possible to distinguish between total food intake and the food allocated at home. Also, since it is not possible to identify whether the reference child consumed a portion of ration received from ICDS on the day of the survey or not, the treatment group is defined as the group of children whose parents report getting the ICDS rations

For children younger than three years, there is no robust evidence of impact of the ICDS on energy or protein or micronutrient intakes (Table 4), with only one of three methods yielding a significant but perverse estimates; the ICDS has clearly not had a positive impact on food intakes for this age group. All matching methods yield insignificant estimates of impact for iron and vitamin A.

Table 4: Impact of ICDS on energy and nutrient intakes, children 1 to 3 years receiving take-home rations

Outcomes	Unmatched differences	Nearest Neighbour Matching	Covariate Matching	Kernel Matching
Calories (kcal per day per child)	-182**	-180***	-125	-161
	(77.47)	(64.37)	(82.84)	(129.22)
Proteins (grams per day per child)	-4.6**	-3.4**	-3.5	-3.3
	(2.10)	(1.80)	(2.14)	(3.45)
Iron (mg per day per child)	-1.6*	-1. 6	-0.8	-1.2
	(0.90)	(1.96)	(0.77)	(1.46)
Vitamin A (mcg per day per child)	-5	115	248	-80
	(199.00)	(177.92)	(167.35)	(267.80)

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: Sample size is 102.

Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

4.4 Robustness checks

The validity of the impact estimates presented in the sub-sections above rests on the assumption that selection into the ICDS is based on observables. While this assumption cannot be tested directly, a number of robustness checks can be performed, by assessing the quality of matching and varying some of the assumptions used to generate the impact estimates.

Quality of Matching

One way to assess whether the matching exercises succeeded in creating an appropriate counterfactual group is to compare the balancing of each covariate independently after matching. Whatever statistically-significant differences there may have been between participants and non-participants before matching, these should vanish after matching; Appendix Tables A.1-A.3 suggest that this is indeed the case: there is no significant difference in means of the covariates after matching.[19]

Another involves measuring joint significance of all covariates, by comparing the Pseudo-R^2 before and after matching (Caliendo and Kopeinig, 2008). As indicated in Table 5, Pseudo- R^2s before matching are significant while those after matching are not, suggesting that the quality of matching was good.

Table 5: Results for Pseudo-R^2 test conducted to evaluate matching quality

Outcomes	Before matching	After matching: Nearest Neighbour Matching	After matching: Kernel Matching
Full sample	0.19***	0.05	0.03
Children aged 3-6 years	0.22***	0.06	0.04
Children aged 1-3 years	0.28*	0.19	0.17

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013
***, ** and * indicate significance at 1, 5, and 10 percent respectively.

Redefining treatment and control groups

The treatment group has thus far been defined as any child who participated in the ICDS in the last 3 months. As an alternative, the treatment group may also be defined as the subset of children who consumed cooked meal *on the day of the surve*y, and compare their outcomes to those who did not participate in the SN program. This is relevant for children 3-6 years of age, impact estimates for whom are presented in Table 6. Even though this leads to a reduction in overall sample size from 212 to 175, the impact estimates are considerably stronger, and suggest that children receiving cooked meals from the ICDS center on the day of the survey and no difference in energy intakes from food consumed at home. Similarly their protein intakes were 8.7 to 9.6 grams higher, vitamin A intakes 312 to 401 mcg higher and iron intakes 3.5 to 3.6 mg higher. These magnitudes are, not unexpectedly, all higher than those reported in Table 3; unlike in Table 3, this restricted sample shows positive impact on vitamin A intakes as well (which were earlier insignificant). And, there is no evidence of any substitution of proteins or the two micronutrients in the food consumed at home.

Adjustment for meals consumed outside

As discussed in section 2.2 for the 12 children who consumed a non-ICDS meal or snack outside the home, the caloric intakes were adjusted assuming that the energy content of such a (full) meal is 403 calories. One way to assess how this might influence results is to assume that these provide a much lower amount of energy—as represented by the lower bound of the 95%

[19] A comparison of the distribution of propensity scores also shows considerable overlap; these are not presented here for reasons of space.

confidence interval used by Tandon and Landes (2011). The resulting impact estimates, presented in Table 7, suggest that the results for remain the same for the full sample and for children 3-6 years old. However, there appears to be a negative (perverse) impact on children 1-3 years old, unlike the case in Table 3.

Table 6: Impact of consuming cooked meal at *anganwadi* center on energy and nutrient intakes, children 3-6 years

Outcomes	Unmatched differences	Nearest Neighbour Matching	Covariate Matching	Kernel Matching
	Calories (kcal per day per child)			
Actual intake	184***	286***	243***	257**
(home + actual transfer)	(64.04)	(58.36)	(74.03)	(100.09)
Intended transfer	298***	400***	357***	371***
(home + intended transfer)	(64.04)	(58.36)	(74.03)	(100.09)
At home	-202***	-100*	-143*	-129
Consumption	(64.04)	(58.36)	(74.03)	(100.09)
	Proteins (grams per day per child)			
Actual intake	8.1***	8.7***	9.6***	9.1***
(home + actual transfer)	(1.81)	(0.89)	(2.07)	(2.84)
Intended transfer	9.9***	10.5***	11.4***	10.9***
(home + intended transfer)	(1.81)	(0.89)	(2.07)	(2.84)
At home	-3.6**	-3.0***	-2.1	-2.6
Consumption	(1.81)	(0.89)	(2.07)	(2.84)
	Iron (mg per day per child)			
Actual intake	2.6***	3. 5***	3. 5***	3.6***
(home + actual transfer)	(0.75)	(1.00)	(0.87)	(1.16)
Intended transfer	3. 5***	4.4***	4.4***	4.5***
(home + intended transfer)	(0.75)	(1.00)	(0.87)	(1.16)
At home	-0.4	0.6	0.6	0.7
Consumption	(0.75)	(1.00)	(0.87)	(1.16)
	Vitamin A (mcg per day per child)			
Actual intake	-20	313**	401***	320
(home + actual transfer)	(293.56)	(135.79)	(155.27)	(442.72)
Intended transfer	55	388***	476***	395
(home + intended transfer)	(293.56)	(135.79)	(155.27)	(442.72)
At home	-271	62	150	69
Consumption	(293.56)	(135.79)	(155.27)	(442.72)

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: Actual intake is a sum of intake at home and that provided through ICDS meal. Intended transfer is a sum of intake at home and the number of nutrients ICDS program intends to transfer to the child. Sample size is 175. Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

Table 7: Impact of ICDS program on intakes of calories (kcal per day per child) among participants, adjusting meals consumed outside by 218 calories

Outcomes	Unmatched differences	Nearest Neighbour Matching	Covariate Matching	Kernel Matching	Observations (#)
		Full sample			
Actual intake	32	65	65	62	314
(home + actual transfer)	(46.06)	(45.47)	(49.85)	(63.78)	
Intended transfer	82*	115**	116**	112*	314
(home + intended transfer)	(47.62)	(46.83)	(51.31)	(65.12)	
At home	-128***	-95**	-94**	-98	314
Consumption	(44.00)	(43.92)	(47.33)	(62.02)	
		Children aged 3-6 years			
Actual intake	108*	174***	158**	183**	212
(home + actual transfer)	(55.43)	(54.89)	(64.01)	(84.60)	
Intended transfer	180***	246***	230***	255***	212
(home + intended transfer)	(56.81)	(56.62)	(65.14)	(85.68)	
At home	-119**	-53	-69	-44	212
Consumption	(54.63)	(52.91)	(62.61)	(83.98)	
		Children aged 1-3 years			
At home	-142**	-187***	-132*	-172	102
Consumption	(70.03)	(46.80)	(75.78)	(110.13)	

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: Actual intake is a sum of intake at home and that provided through ICDS meal. Intended transfer is a sum of intake at home and the number of nutrients ICDS program intends to transfer to the child.

Standard error in parentheses; ***, ** and * indicate significance at 1, 5, and 10 percent respectively.

5. Summary and Conclusions

This paper has tried to contribute to the evidence on the impact of the ICDS by focusing on food intakes of preschool children. While programs such as the Public Distribution System provide subsidised food to the household as a whole, the ICDS specifically targets young children. Its success in improving intakes depends on the degree to which households substitute away the food provided at the center by reducing food allocated at home. The paper attempted to quantify this for calories, proteins, vitamin A and iron.

Although take-home rations are in principle more fungible as it is easy to reallocate these to other household members, or simply be merged with the household pot (as compared to cooked meals that are provided to the child), the provision of cooked meals does not necessarily mean that there is no leakage, if parents compensate in part or completely for the meal. There is weak evidence that this is happening in Bihar, but the net effect is still positive.

Taken together, the evidence presented above suggests that as far as energy is concerned, there is ample evidence that for children 3-6 years of age, who benefit from cooked food provided at the *anganwadi*, the ICDS did result in higher intakes—of about one-third of the intended transfer. A net increase in actual calorie intake by 117-162 calories translates into a reduction in prevalence of undernourishment by 11-14 percentage points.

This also true of protein intakes; with increased intakes translating into a 15-16 percentage point decrease in the proportion of children with inadequate intakes.

For iron, the ICDS translated into higher actual and intended intakes, with increased intakes amounting nearly two-thirds of the intended transfer, and 10-14 percentage point reduction in the prevalence of inadequate intakes. There is no evidence that as a consequence, iron from food provided at home declined; presumably because the food consumed at home is not iron-rich. There appears to be no strong evidence of impact on vitamin A intakes.

For children in the age group 1-3 years, whose mothers are given take-home rations, there is no evidence of improved intakes of calories or any of the other nutrients as a consequence of participating in the SN program; one specification done as part of the robustness checks, yields perverse results.

Thus impact estimates vary substantially depending on the age-group. There is clear evidence of an increase in the quantity of food (calories) consumed by 3-6 year-old children but none for the younger 1-3 year-old children. This is also true of diet quality, as captured by intakes of iron and proteins. Only vitamin A intakes remain unaffected by the transfer for both age groups.

At first glance, these differences across age groups are puzzling, since as noted in the introduction, the magnitude of the implied income transfer is the same irrespective of whether cooked meals are provided or take-home rations are given. Since the ICDS transfers are clearly infra-marginal, only an income effect should be relevant. There is evidence that income elasticities for calories are small, not only for households but also for young children. For example, Behrman and Deolalikar (1990) estimate the income elasticity of demand for calories and nutrients in South India to be near-zero for children. In later work, Roy (2001) and Jha et al. (2009) estimate a non-zero but numerically small income elasticity of demand for calories, ranging from 0.06 to 0.09. Behrman and Deolalikar (1990) and Jha et al. (2009) also estimate income elasticity for proteins and iron. While the former found these income elasticities to be not statistically different from zero (for children), Jha et al. (2009) estimate the income elasticity for proteins and iron to be 0.2; values that are corroborated by this data. However, any income-elasticity based explanation should hold equally for both groups of children, which is clearly not the case.

Similarly, any flypaper effect, by which the public transfer of food does not completely crowd out food allocated by parents to the child at home, so that there is a net increase in food intakes of the target child, should be evident for both mechanisms. This is especially the case since the take-home rations are only provided to the mother, with the explicit understanding that this was meant for her toddler; thus a gender-based explanation (with fathers less likely to invest in their children than mothers) is not applicable here.

But clearly, the mode of transfer does seem to matter to the impact of the ICDS on food intakes. Although the confound between age group and transfer mechanism precludes a definitive statement, the evidence in this paper is consistent with other literature on whether the mode of transfer matters to outcomes. An early study of five countries with supplementary food programs found that while 78-86 percent of children consumed food from on-site feeding, only 50 percent of children who received take-home rations did so (cited in Kennedy and Alderman, 1987). In Mexico city, a milk subsidy program had 83 percent of recipients reporting that at least some of the milk was used by adults, thereby reducing the amount that was consumed by the intended beneficiaries, namely pre-schoolers. Some countries such as Guatemala have tried (successfully) to provide an on-site feeding as a snack, in the expectation that it would perceived differently than a meal, and therefore reduce substitution of food at home. This suggests that one explanation for the results in these papers and the findings of this study is that parents have a different behavioural response to transfers such as cooked meals, that are targeted specifically to children.

A related literature has also examined whether the marginal propensity to consume from cash differs from in–kind transfers. For example del Ninno and Dorosh (2003) find that for poor housholds, the marginal propensity to consume wheat from in-kind transfers was about 0.25, while that from cash income was near zero.

These results imply that ICDS is an effective instrument to improve the dietary quantity and quality, of children above 3 years of age. Ensuring that the ICDS meals are also rich in micronutrients can go a long way in reducing the deficit in micronutrient intakes, which are at a very low level.

The lack of impact on younger children is troubling, given that they are more vulnerable to undernutrition. Note that these children likely benefit from other components of the ICDS, including vaccinations, health checks and nutrition educations (of their mothers); these benefits are not considered here. Take-home rations may be more practical since toddlers cannot eat by themselves but such rations can also easily be merged with the family pot. Solutions that better targeted to his age group are warranted, that may include, for example, home-fortified food that is not as readily fungible, and only consumed by young children.

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Appendix Table A.1: Comparison of means - pre and post matching, full sample

Variables		Nearest Neighbour Matching	Kernel Matching
	Difference in means before matching#	Difference in means after matching#	Difference in means after matching#
Age of the child (months)	-2.73	3.07	3.37*
Male (dummy)	0.03	-0.05	-0.03
Birth order†	0.20	0.08	0.15
Child fell ill in past one month (dummy)	-0.03	0.05	0.03
Size at birth††	-0.04	-0.08	-0.05
Breastfed on the day of the survey (dummy)	0.03	0.00	-0.02
Number of siblings of the child	0.27*	0.14	0.19
Time taken to visit ICDS developed (minutes)	-3.03***	-1.43	-1.19
Same caste as ICDS worker (dummy)	0.16***	0.03	0.00
Used ICDS prior to 3 months before the survey	0.26***	-0.02	-0.01
Mother's age (years)	0.30	0.64	0.72
Literate Mother (dummy)	-0.11*	0.02	0.01
Working mother (dummy)	0.03	0.02	0.03
Time spent by mother is child care (hours)	-0.15	-0.35	-0.32
Nutritional knowledge index of mother†††	-0.28***	-0.02	0.03
Bargaining power index of mother††††	-0.59**	-0.03	-0.10
Father's age (years)	1.23	0.76	1.02
Literate Father (dummy)	0.05	0.00	0.01
Non-migrant father (dummy)	-0.08	-0.05	0.01
Household size	0.13	-0.02	-0.26
Number of alternative female caregivers	-0.09	-0.12	-0.13
Asset owned†††††	-0.27***	-0.03	-0.01
Defecating in open (dummy)	0.15***	-0.02	-0.03
Using clean fuel (dummy)	-0.08*	0.01	0.03
Caste-SC (dummy)	0.13***	0.01	0.01
Caste-OBC (dummy)	0.00	-0.02	-0.02
Caste-Other (dummy)	-0.13***	0.01	0.01
Village 1 in developed district (dummy)	-0.08	-0.02	0.00
Village 2 in developed district (dummy)	-0.07	0.00	0.01
Village 1 in underdeveloped district (dummy)	-0.01	0.04	0.03
Village 2 in underdeveloped district (dummy)	0.15***	-0.02	-0.04
Number of observations	314	314	314

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013

Notes: # - Difference in mean = Mean of treatment group – Mean of control group

† - Birth order 1 is assigned to first born child, and an increasing value is assigned to subsequently born children.
†† - size at birth was measured using a 5-point hedonic scale, with 1 implying very small and 5 implying very large. ††† - an index for knowledge constructed using PCA. †††† - an index for mother's bargaining power constructed using PCA. ††††† - an index for number of assets owned constructed using PCA.

Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.

Appendix Table A.2: Comparison of means of observables, pre and post matching, children aged 3 to 6 years

Variables		Nearest Neighbour Matching	Kernel Matching
	Difference in means before matching#	Difference in means after matching#	Difference in means after matching#
Age of the child (months)	-3.83**	1.35	2.27
Male (dummy)	0.03	0.03	-0.03
Birth order†	0.10	0.14	0.20
Child fell ill in past one month (dummy)	-0.02	0.03	-0.01
Size at birth††	-0.04	0.00	-0.06
Number of siblings of the child	0.24	0.13	0.10
Time taken to visit ICDS developed (minutes)	-3.49**	-0.89	-0.33
Same caste as ICDS worker (dummy)	0.16**	0.01	-0.03
Used ICDS prior to 3 months before the survey	0.31***	0.01	0.01
Mother's age (years)	-0.04	0.84	1.05
Literate Mother (dummy)	-0.08*	0.03	0.00
Working mother (dummy)	0.02	0.03	0.04
Time spent by mother is child care (hours)	-0.09	-0.33	-0.43
Nutritional knowledge index of mother†††	-0.32***	-0.08	-0.03
Bargaining power index of mother††††	-0.46*	-0.35	-0.30
Father's age (years)	0.64	1.34	1.43
Literate Father (dummy)	0.02	-0.07	-0.07
Non-migrant father (dummy)	-0.08	-0.10	-0.03
Household size	0.17	0.19	0.14
Number of alternative female caregivers	-0.08	-0.04	-0.08
Asset owned†††††	-0.24***	-0.05	0.00
Defecating in open (dummy)	0.13**	0.00	-0.01
Using clean fuel (dummy)	-0.08	-0.02	0.03
Caste-SC (dummy)	0.06	0.06	0.00
Caste-OBC (dummy)	0.05	-0.10	-0.03
Caste –Other (dummy)	-0.11**	0.04	0.03
Village 1 in developed district (dummy)	-0.06	-0.01	-0.01
Village 2 in developed district (dummy)	-0.08	0.01	0.04
Village 1 in underdeveloped district (dummy)	-0.04	-0.06	-0.10
Village 2 in underdeveloped district (dummy)	0.18***	0.06	0.07
Number of observations	212	212	212

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013
Notes: # - Difference in mean = Mean of treatment group – Mean of control group
† - Birth order 1 is assigned to first born child, and an increasing value is assigned to subsequently born children. †† - size at birth was measured using a 5-point hedonic scale, with 1 implying very small and 5 implying very large. ††† - an index for knowledge constructed using PCA. †††† - an index for mother's bargaining power constructed using PCA. ††††† - an index for number of assets owned constructed using PCA.
Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.

Appendix Table A.3: Comparison of means of observables, pre and post matching, children aged 1 to 3 years

Variables		Nearest Neighbour Matching	Kernel Matching
	Difference in means before matching[#]	Difference in means after matching[#]	Difference in means after matching[#]
Age of the child (months)	0.56	2.42*	1.63
Male (dummy)	0.03	-0.03	-0.09
Birth order[†]	0.44*	0.47*	0.10
Child fell ill in past one month (dummy)	-0.05	-0.14	-0.18
Size at birth[††]	-0.02	-0.03	0.03
Breastfed on the day of the survey (dummy)	0.11	-0.01	-0.02
Number of siblings of the child	0.35	0.29	0.11
Time taken to visit ICDS developed (minutes)	-2.03	-1.99	-5.71**
Same caste as ICDS worker (dummy)	0.17*	-0.06	-0.07
Used ICDS prior to 3 months before the survey	0.16*	0.06	0.02
Mother's age (years)	1.13	0.33	0.84
Literate Mother (dummy)	-0.16	0.15	0.04
Working mother (dummy)	0.04	0.02	0.04
Time spent by mother is child care (hours)	-0.34	-0.43	-0.32
Nutritional knowledge index of mother[†††]	-0.20	0.08	-0.13
Bargaining power index of mother[††††]	-0.83	-0.68	-0.53
Father's age (years)	2.57*	1.56	1.49
Literate Father (dummy)	0.10	0.03	0.07
Non-migrant father (dummy)	-0.08	0.13	-0.07
Household size	0.06	-0.59	0.41
Number of alternative female caregivers	-0.13	-0.17	0.27
Asset owned[†††††]	-0.34**	-0.13	-0.21
Defecating in open (dummy)	0.17**	-0.02	0.05
Using clean fuel (dummy)	-0.08	0.04	0.01
Caste-SC (dummy)	0.27***	0.01	-0.07
Caste-OBC (dummy)	-0.10	-0.03	0.06
Caste-Other (dummy)	-0.16**	0.02	0.01
Village 1 in developed district (dummy)	-0.11	0.03	-0.15
Village 2 in developed district (dummy)	-0.03	0.00	0.05
Village 1 in underdeveloped district (dummy)	0.06	0.02	0.06
Village 2 in underdeveloped district (dummy)	0.08	-0.05	0.05
Number of observations	102	102	102

Source: Based on primary survey data collected by authors in Bihar in Feb-April, 2013
Notes: [#] - Difference in mean = Mean of treatment group – Mean of control group
[†] - Birth order 1 is assigned to first born child, and an increasing value is assigned to subsequently born children. [††] - size at birth was measured using a 5-point hedonic scale, with 1 implying very small and 5 implying very large. [†††] - an index for knowledge constructed using PCA. [††††] - an index for mother's bargaining power constructed using PCA. [†††††] - an index for number of assets owned constructed using PCA.
Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.