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# UTILIZATION OF ICDS SERVICES AND THEIR IMPACT ON CHILD HEALTH OUTCOMES EVIDENCE FROM THREE EAST INDIAN STATES

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# Utilization of ICDS services and their impact on child health outcomes

## Evidence from three East Indian states

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**Abstract**

The study analyses a rural household's decision to participate in a public pre-school intervention called the Integrated Child Development Scheme (ICDS), and evaluates its impact on anthropometric outcomes of children in three Indian states, namely Bihar, Jharkhand and Orissa in the year 2012. Using multinomial logistic models, we find that access costs, defined both in physical (distance) and social (caste) terms, are the main drivers of ICDS utilization. We also estimate the impact of utilization of one or more of the multiple services offered by the ICDS on anthropometric outcomes, by using matching methods. Our results suggest that conditional on utilization, compared to singleton services, utilization of multiple services translates into larger increase in weight-for-age z-scores. Participation in all the services of the ICDS program leads to a 13 percentage points lower prevalence of underweight children. Given the evidence that relatively greater emphasis is placed on the supplementary nutrition component of the program, these results are not surprising.

## 1. Introduction

India's progress in reducing the prevalence rates of undernutrition among children, measured by stunting (low height-for-age z-scores) and underweight (low weight-for-age z-scores) has been dismal; and in 2005-06 these rates were higher than those in many countries which have much lower per capita GDP than India, including Pakistan, Nepal, Burkina Faso, Ghana, and Somalia.[1] The National Family Health Survey (NFHS) show that over approximately a period of 15 years (1992-93 to 2005-06) the prevalence rates of stunting and underweight have declined only by 4 and 10.5 percentage points, respectively.[2] A recent report published by United Nations shows a much steeper decline in past the 10 years, in that underweight prevalence was 27 percent in 2013-14, a decline of 15.5 percentage points

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[1] Height-for-age and weight-for-age z-scores below -2 standard deviations from median of reference population are referred to as being stunted and underweight respectively (NFHS-3).

[2] The prevalence rates of stunting and underweight were 52 and 53 percent, respectively in 1992-93, which reduced to 48 and 42.5 percent in 2005-06.

(United Nations 2015). This is corroborated by data for several states from the fourth District Level Household Survey conducted in 2012-13.

The Integrated Child Development Scheme (ICDS), also known as *Anganwadi Yojana*, is a major preschool intervention by the Government of India. It was launched in 1975 with the aim of reducing malnourishment levels and was targeted at children in age group of 0-6 years, and pregnant and lactating mothers. There are various components of the ICDS program that are offered for children, namely, supplementary nutrition, immunization, health check-ups, growth monitoring, preschool education and nutrition education to their mothers.[3] These components may be classified into two groups (Table 1): the first category is *nutrition*, which includes cooked meals or take-home rations, while the other services listed above may be included in what we refer to as the *health investment* category.[4] The rationale for this two way classification of ICDS services is given in section 3.

Table 1: Services offered by Integrated Child Development Scheme (ICDS) to children

| ICDS services | Children aged 6 months to 3 years | Children aged 3 to 6 years |
|---|---|---|
| Supplementary Nutrition | Take-home rations | Cooked meals |
| Health Investment | Vaccination<br>Growth monitoring<br>Health check up<br>Nutrition education to mothers | Vaccinations<br>Growth monitoring<br>Health check up<br>Nutrition education to mothers |

Source: Constructed by author based on information sourced from http://wcd.nic.in/icds/icds.aspx, accessed on 17th August, 2015.

Since the universalization of all the services of the program in 2006, there has been a rapid expansion in the coverage. As compared to only one-third of the villages having an ICDS centre in 1992-93 (NFHS-1), 91 percent of all villages had an *anganwadi* centre in 2005-06 (NFHS-3). Despite the expansion in coverage, when compared with number of *anganwadi* centres required as per the population norms, the Program Evaluation Organization (PEO) of the Planning Commission (PEO 2011) finds that there was a shortfall of about 30 percent in coverage in 2009.

[3] Supplementary nutrition refers to the food provided at the ICDS centre to its beneficiaries. Six vaccines for DPT, polio and measles are provided through ICDS centre. As part of growth monitoring, ICDS workers track the weight of children to ensure that they are not lagging behind. In addition, children in this age group are also offered pre-school education. Preschool education to children entails teaching of alphabets, numbers, rhymes etc., along with physical activities for children and imparting basic health education to them. These services are provided through childcare centres, known as *anganwadi* centres. Each centre is managed by an *anganwadi* worker (AWW) and a helper.

[4] Our survey conducted at the ICDS centres reveals that no physical activities were undertaken at any of the ICDS centres. In this situation, preschool education is not likely to affect health outcomes; it may affect cognitive outcomes. Therefore, for our analysis utilization of this service is not of much consequence and is not considered.

The expansion in coverage has not translated into a proportionate increase in utilization. The NFHS-3 survey data indicates that only 35 percent of households utilized some service from ICDS in 2005-06. More recent data from the Ministry of Women and Child Development (MoWCD (a)) indicates that in 2012, 79 million children were provided with supplementary nutrition (this represents about 50 percent of the population of children between 6 months to 5 years of age according to the Census (2011)) and 35 million children were provided with preschool education. Thus, utilization figures are far lower than those suggested by the expansion in the coverage of ICDS centres.

There are several dimensions to the low utilization rates. First, lack of utilization may reflect lack of availability. The PEO (2011) study referred to earlier, states that nearly 30 percent of the registered beneficiaries could not benefit from supplementary nutrition as the food was just not available at the ICDS centre. To the extent that non-participation is due to supply constraints, it is clearly not a conscious choice by parents to do so. Second, parents may not be aware of their entitlements or services provided at the centre. Thus, lack of information might lead to low utilization, even if services are available. Last, parents may voluntarily choose not to avail any or some of the ICDS services for their children. This may, for example, be true of those who are well-off and prefer to avail these services through private providers.

Given availability, a household's decision to participate selectively can be affected by various factors, such as the distance to centre, opportunity cost of time, and the quality of services provided. Additionally, social discrimination based on caste and gender has been identified as an important limiting factor in accessing development programs, and this holds for ICDS participation as well (Mander and Kumaran, 2006; and CIRCUS 2006). However, reasons for low and selective participation and relative importance of these factors for each of the ICDS services have not been analysed in the literature. The first objective of this study is to address this gap by examining the factors that affect a household's decision to utilize none, either, or both ICDS services.[5] In doing so, we account for the fact that certain services may not be available to certain households (due to actual or perceived lack of supply), and that these households therefore face a smaller choice set.[6]

Apart from understanding the principal drivers of the utilization of various ICDS services, it is equally important to assess whether utilization leads to improvements in child health (measured as weight-for-age (WAZ) and height-for-age (HAZ) z-scores). Each of the two key services of the ICDS, supplementary nutrition and health investment, can be expected to improve health outcomes. By increasing food intake of children, supplementary nutrition can ensure that children achieve their growth potential. Similarly, by improving mother's nutritional knowledge, health investments can lead to improved health outcomes of children, while vaccinations enable children to fight diseases better and thus be less

[5] We examine the factors that affect the utilization of nutrition and health investment services, and not of each component in these categories. Low sample size for each component makes it econometrically infeasible to study determinants of each component.

[6] Hereafter, the term services refers to nutrition and/or (set of) health investment services, as defined earlier in this section.

susceptible to compromised growth. Therefore, the second objective of this study is to assess whether utilization of ICDS services leads to improvements in health outcomes. In particular, we analyse if utilizing *both* nutrition and health services has a higher impact on health outcomes of children as compared to *partial* utilization of ICDS services, that is, using either of the two services.[7] A higher impact would suggest that there are complementarities in utilizing both ICDS services.[8]

The analysis is based on a primary survey conducted during September-October; 2012 in 11 villages located in Bihar, Jharkhand and Orissa, states in Eastern India. These states are among the worst performers in terms of health outcomes in the country.[9] Perhaps because of this, these states have committed increased resources to the ICDS program in the past few years. The number of ICDS centres in Jharkhand and Orissa grew by 71 and 89 percent respectively between 2007 and 2012 (MoWCD (a) and (b)), which is higher than the all India growth rate of 54 percent; and Bihar is spending double the required amount on supplementary nutrition (PEO 2011).[10]

The rest of the paper is organized as follows. Section 2 gives a summary of literature on evaluation of ICDS program, and section 3 outlines a theoretical model of household decision making. Sampling design and summary statistics are presented in section 4. We discuss the results from multinomial logistic framework to identify socio-economic characteristics associated with higher ICDS utilization in section 5, while the impact estimates from utilization, using propensity score and covariate matching techniques, are presented in section 6. Section 7 summarises and concludes.

## 2. Review of Literature

There are several programs across the world that provide a similar package of comprehensive services as the ICDS. While the literature analyzing the factors that affect uptake of these programs is scant, the evidence on efficacy of these programs in improving anthropometric outcomes is mixed. While Hossain et al. (2005), Behrman et al. (2004) and Schroeder et al. (2002) do not find any impact of comprehensive programs on weight and height of children, Ruel et al. (2008) and White and Masset (2007) find that participation in such programs leads to improvement in WAZ and HAZ scores of young children.

[7] Again due to low sample size, we are unable to estimate the independent impact of utilizing nutrition and health investment bundle on anthropometric outcomes.

[8] We use the terms health outcomes and anthropometric outcomes interchangeably in rest of the text.

[9] Among the 29 states in India in 2005-06, the prevalence rate of stunting in Bihar (55.6%) was second highest among all states (NFHS-3). Jharkhand (49.8%) and Orissa (45%) are also among poor performers with a rank of 23 and 19 respectively (NFHS-3). Similarly, the underweight prevalence rates in Bihar (55.9%) and Jharkhand (56.5%) puts them at 27$^{th}$ and 28$^{th}$ ranks respectively, while Orissa is ranked 22$^{nd}$ (40.7%) among the 29 states (NFHS-3).

[10] In 2009, Jharkhand and Orissa were among the better performing states in ICDS implementation as per PEO (2011); both these states have higher coverage, better delivery of supplementary nutrition component and good infrastructure.

The literature on evaluation of the ICDS in India may be divided into two broad strands. The first pertains to the determinants of utilization of ICDS services, although it is relatively limited. These determinants tend to focus on demand side factors, and have typically not accounted for the fact that low utilization may simply reflect low perceptions of availability (even if actual availability was not a constraint). Jain (2015) finds that utilization of supplementary nutrition service of the ICDS is affected by child's age, mother's education, her health status, household head's education and caste category of the household. PEO (2011) reports that (as expected) beneficiaries of ICDS program are less educated, have a lower probability of belonging to salaried class and have lower monthly per capita expenditure than non-beneficiaries. Demographic characteristics such as mother's age and number of children in the house are other variables that have been found to affect utilization of programs similar to ICDS (White and Masset, 2007; and Behrman et al., 2004).

In addition, the cost of accessing ICDS services also affects their utilization. The probability of a child going regularly to ICDS centre increases by 35 percent if the centre is located in the same hamlet as the child resides in; here distance is a measure of access cost (CIRCUS 2006). Time taken to visit the centre affects utilization rates of a similar program in Bangladesh (White and Masset, 2007).

Another factor which affects utilization of ICDS services is caste discrimination. One way through which it manifests is the discriminatory behavior of the ICDS worker towards the children who belong to lower castes in the social hierarchy, who are often dissuaded from participation (Mander and Kumaran, 2006). Gragnolati et al. (2006) also find that caste of the ICDS worker positively influences the attendance of children from the same caste. Thus, it is not only the demographic characteristics of the household and economic cost of accessing ICDS service, social factors also affect the access and ability to participate in the program. We refer to this as 'social access cost'.[11]

The second strand of studies focuses on the effect of ICDS participation on various anthropometric outcomes. This can further be subdivided into two segments. First, there are studies that analyse the *association* between ICDS participation and anthropometric outcomes. Deolalikar (2005) using NFHS-1 data finds that presence of an ICDS centre reduces the probability of being underweight by 5 percent among boys. In a state level analysis, the PEO (2011) study finds that ICDS has a positive impact on nutritional status of only moderately malnourished children. A few of the studies delve deeper to study the relationship between attending an ICDS centre, (as against presence of centre in village) and anthropometric outcomes. Bredenkamp and Akin (2004) (cited in Gragnolati et al. (2005)) find that for the state of Kerala, attending an ICDS centre is positively associated with better health outcomes. Bhalani and Kotecha (2002) find that despite participating in the ICDS program for two years, there was no change in the malnutrition status of children in Vadodara city. Bhasin et al. (2001), also considering trends over time, find that attending an ICDS centre is not associated with a lower risk of being malnourished after leaving the program.

[11] There is also evidence of discrimination against girls and disabled children (Mander and Kumaran, 2006; and CIRCUS 2006).

These studies therefore suggest that the gains from ICDS are probably modest and not long lasting. Note that, these studies were conducted at a time when its scale of operation was far more limited and also, they do not account for self-selection into participation in the program.

The second sub-class of studies examines the *causal* relationship between ICDS participation and health outcomes, and is based on larger surveys. Lokshin et al. (2005) compare the anthropometric outcomes of children in villages which have an ICDS centre with the ones that do not, using NFHS-1 data. After accounting for selective placement of ICDS centres, they do not find any difference in WAZ scores, but a positive impact of 0.15 standard deviations on HAZ scores of boys in the age group of 0-4 years. Kandpal (2011) extends their analysis and finds that even though the mean impact is insignificant, ICDS had a positive impact on the worst-off children. Presence of an ICDS centre improved the HAZ scores of moderately and severely stunted boys during the first two rounds of NFHS conducted in 1992-93 and 1998-99, respectively. In the third round in 2005-06, however, she finds improvement in both the mean and at the lower end of the distribution. The mean HAZ score in villages with AWC centre was higher by 0.09 standard deviations. All these studies have focused on 'availability' of an ICDS centre at the village, and do not consider utilization by the household. The need to differentiate between 'availability' and 'utilization' is highlighted by Jain (2015). Using matching methods, she finds no impact of availability of ICDS but a positive impact of utilization. Jain (2015) considers the impact of utilizing only supplementary nutrition and finds that children who utilize it every day are about 1 cm taller than those who do not receive supplementary nutrition. The impact estimates from these studies by gender and age-group are summarized in Table 2.

The complementarities between various ICDS services may require use of all services together to have any impact on health outcomes. One such study that considers the differential impact of partial and full ICDS utilization is Saiyed and Seshadri (2000). Using data for urban areas for preschool children, they find that compared to partial utilization of ICDS services, complete utilization of ICDS services has a positive effect on anthropometric outcomes. A simple comparison of mean z-scores of "full" users (who use all ICDS services) with "partial" users (who use some of the ICDS services) showed that z-scores of full users were 0.7 standard deviations higher than partial users for HAZ scores. The difference in WAZ scores was higher than 1 standard deviation.

This paper contributes to the literature in several aspects. First, we explicitly account for difference between supply as defined by service provider and, users' perceptions of availability. There is a need to make this distinction because even if all services were available, utilization rates may be low if users are unaware of it. Second, we account for a more comprehensive set of determinants that may affect ICDS utilization, and incorporate access costs through caste identities of participants and the ICDS worker, and through distance to ICDS centre. Third, to measure the effectiveness of ICDS program in improving health outcomes, we delve deeper than just a binary decision of participation, and consider intensity of participation, to see if there are complementarities in impact. Specifically, we examine whether utilizing both services leads to higher impact measures than a single service. This aspect has received scant attention in the literature thus far. Finally, most of the

literature uses data prior to 2005. This paper is among the more recent impact evaluations of the ICDS; more than 50 percent of the expansion in ICDS coverage has happened after 2005, a period which has seen a restructuring of the ICDS.

Table 2: Estimated impact of ICDS participation on Weight-for-age (WAZ) and Height-for-age (HAZ) z-scores by other studies

| Studies | Data Source | Age (years) | WAZ | | | HAZ | | |
|---|---|---|---|---|---|---|---|---|
| | | | All | Girls | Boys | All | Girls | Boys |
| Impact of ICDS participation on z-scores (at mean) | | | | | | | | |
| Lokshin et al. (2005) | NFHS I | 0-4 | -0.04 | 0.00 | 0.01 | 0.06 | 0.01 | 0.15** |
| | | | (0.04) | (0.06) | (0.05) | (0.06) | (0.08) | (0.08) |
| | NFHS II | 0-3 | 0.00 | -0.13 | 0.04 | 0.02 | -0.06 | 0.10 |
| | | | (0.05) | (0.09) | (0.07) | (0.06) | (0.10) | (0.07) |
| Kandpal (2011) # | NFHS I | 0-4 | | | | 0.03 | 0.09 | 0.14** |
| | | | | | | (0.06) | (0.08) | (0.08) |
| | NFHS II | 0-3 | | | | 0.03 | 0.05 | 0.01 |
| | | | | | | (0.03) | (0.04) | (0.04) |
| | NFHS III | 0-2 | | | | 0.06** | 0.04 | 0.09** |
| | | | | | | (0.04) | (0.05) | (0.05) |
| | NFHS III | 0-3 | | | | 0.08*** | 0.07 | 0.08** |
| | | | | | | (0.03) | (0.04) | (0.04) |
| | NFHS III | 0-5 | | | | 0.09*** | 0.10 | 0.07 |
| | | | | | | (0.03) | (0.04) | (0.04) |
| Jain (2015)## | NFHS III | 0-2 | | 0.15 | 0.20** | | 0.44*** | 0.41** |
| | | | | (0.09) | (0.10) | | (0.17) | (0.20) |
| Impact of ICDS participation on z-scores of moderately and severely stunted children | | | | | | | | |
| Moderately stunted | | | | | | | | |
| Kandpal (2011) # | NFHS I | 0-4 | | | | 0.01 | 0.04 | 0.02 |
| | | | | | | (0.02) | (0.03) | (0.03) |
| | NFHS II | 0-3 | | | | 0.01 | 0.00 | 0.03*** |
| | | | | | | (0.01) | (0.01) | (0.01) |
| | NFHS III | 0-5 | | | | 0.02*** | 0.03** | 0.00*** |
| | | | | | | (0.01) | (0.02) | (0.01) |
| Severely stunted | | | | | | | | |
| Kandpal (2011) # | NFHS I | 0-4 | | | | 0.06 | 0.00 | 0.22*** |
| | | | | | | (0.05) | (0.07) | (0.06) |
| | NFHS II | 0-3 | | | | 0.01 | 0.00 | 0.00 |
| | | | | | | (0.03) | (0.03) | (0.03) |
| | NFHS III | 0-5 | | | | 0.04 | 0.08 | 0.01*** |
| | | | | | | (0.03) | | (0.04) |

Source: Constructed by author from Lokshin et al. (2005), Kandpal (2011) and Jain (2015).
Notes: # - Kandpal (2011) did not analyse the impact of ICDS availability on WAZ scores, ## - Jain (2015) estimates impact of utilizing only supplementary nutrition service. Also, her results for impact on weight-for-age z-scores were not robust.
Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.

## 3. Conceptual Framework

To understand the decision of a household to participate in the ICDS program, we outline a simple model of household decision-making, building on the framework used by, among others, Becker (1981) and Pitt and Rosenzweig (1985). We assume a household with parents (*p*) and a child (*c*). Parents, treated as a single entity, are the decision makers, and the household's utility is synonymous with parents' utility. Parents derive utility from consumption of food ($F^p$), non-food goods ($G^p$) and their health status ($H^p$). We assume that parents are altruistic towards their child; their utility therefore also depends on child's utility ($W^c$), which in turn has the same arguments, namely, consumption of food and non-food goods, and their health status. The *household utility function* ($W^h$) can then be written as:

$$W^h = W^h(F^p, G^p, H^p, W^c(F^c, G^c, H^c)) \quad \ldots(1)$$

We assume the utility and the sub-utility functions to be concave, double differentiable and increasing in all arguments. Utility is maximized subject to health production function and income constraints.

The health production function of the parents is given by (Rosenzweig and Schultz, 1983).

$$H^p = H^p(F^p, IH^p, X) \quad \ldots(2)$$

There are two major inputs that affect health outcomes. The first is food intake (*F*) which has a positive effect on health outcomes. Food intake, therefore, affects the utility of the household directly and also through health outcomes. The second is health investments (*IH*), which comprise of inputs such as medicines, micronutrient supplements and vaccines, which complement food intake. These health inputs have no direct effect on utility of the households, unlike food intake. Other factors such as health endowment of the individual, the environment in which an individual lives, economic status of the household and education, which also have a bearing on health outcomes, are included in vector *X*.

The child's health production function takes an additional argument $U_j^c$, where *U* is the set of ICDS services available to the household and *j* refers to the element in the set which is utilized. Both the services provided by ICDS – nutrition and health investment – can complement or substitute consumption of food (*F*) and health investments (*IH*) which are provided through private resources. The child's *health production function* is therefore given by equation 2 *a*.

$$H^c = H^c\left(F^c, IH^c, U_j^c, X\right) \quad \ldots(2\ a)$$

The family is assumed to earn a fixed income *I*, which is spent on food and non-food goods, health investments and utilization of ICDS program ($U_j^c$). The *budget constraint* can be written as:

$$I = P_F \sum_{i=p,c} F^i + P_G \sum_{i=p,c} G^i + P_{IH} \sum_{i=p,c} IH^i + C_j U_j \quad \ldots(3)$$

In the above equation, $P_F$, $P_G$ and $P_{IH}$ are the prices associated with food and non-food goods, and health investments respectively. $C_j$ is the cost of utilization of $j^{th}$ ICDS service. Though these services are available free of cost at the ICDS centre, the household may incur certain other costs in using these services. Such costs include transportation cost and opportunity cost of the time spent in visiting the centre. We term these as economic access costs. As the literature indicates the importance of social standing in affecting the access to ICDS services, access costs may also include social costs. We capture these through caste of the beneficiary and ICDS worker. A household will utilize ICDS services only if the utility gains from utilization are at least as high as access costs.[12]

As noted earlier, ICDS services may be categorized into two groups – nutrition and health investment. The rationale for such a classification is that each of these services is distinct and may be viewed differently by households. That better food translates in better health outcomes is common knowledge, and so it may be easier to convince parents to participate. However, the contribution of vaccines and nutrition education to health outcomes is indirect and therefore, may not be perceived as valuable, and thus have fewer takers.

A household thus has four choices – it can decide not to participate, or to choose only nutrition services, or to choose only health investment services, or it can choose both nutrition and health investment services. We call the fourth alternative as the *comprehensive* alternative. $U_j$ therefore is a discrete variable, $U_j \in \{0, \ldots, 3\}$, representing the alternative chosen by the household (0 is for non-participation).[13]

The number of ICDS services offered varies by the age of child; therefore children of all age groups are not eligible for every alternative. Children below 6 months of age are eligible only for health investment component and therefore have 2 alternatives to choose from. Children above 6 months of age are eligible for all ICDS services and therefore have a full choice set of 4 alternatives. Another factor that can cause difference in the number of choices available across households is lack of supply – both actual and perceived. This means some services (alternatives) are in effect not in the household's choice set. If $M$ is the number of alternatives an individual is eligible for and $K$ is the number of eligible alternatives that are not available to a household, then $M - K$ is the number of eligible alternatives actually available. Thus, the choice set faced by a household varies by eligibility and availability.

The household maximizes utility function (eq. (1)) subject to health production function (eq. (2) and (2 $a$)) and income constraint (eq. (3)), with respect to level of consumption of food, non-food and health investments, and which ICDS service to utilize.

[12] While there might be no difference in the social cost of accessing different ICDS services, the economic cost might differ by the type of service and age group of the child due to differences in frequency of visit. For instance, supplementary nutrition is provided as hot-cooked meals served six days a week at the centre, to children above the age of 3 years, while children below 3 years are provided take-home rations that are distributed once a month. Thus the economic cost might be higher for older children as compared to young ones.

[13] We use the terms service, component and alternative interchangeably.

As the model outlined above has a discrete variable, $U_j$, standard maximization techniques cannot be used to yield demand functions. The utility maximizing choice can be arrived at by comparing the utility derived from each of the alternatives in the utilization choice set. For each of the alternatives, the conditional (on utilization) utility function can be defined as:

$$W^h_{|U^c_j} = W^h\left(F^p, G^p, H^p, W^c(F^c, G^c, H^c)|\ U^c_j\right) \qquad \ldots.(4)$$

The above function is maximized subject to the two constraints. This exercise yields the following demand functions for food and non-food consumption, and health investments:

$$F^i_{|U^c_j} = F^i\left(I - C_j, P_F, P_G, P_{IH}, X\middle|U^c_j\right), \qquad i = p, c$$

$$G^i_{|U^c_j} = G^i\left(I - C_j, P_F, P_G, P_{IH}, X\middle|U^c_j\right), \qquad i = p, c$$

$$IH^i_{|U^c_j} = IH^i\left(I - C_j, P_F, P_G, P_{IH}, X\middle|U^c_j\right), \qquad i = p, c$$

The utility level can then be derived for each of the *j* alternatives in the choice set. If $W'_j$ represents utility at utilization level *j*, then the chosen level of utilization (*J*) is such that utility is maximized ($W_J$).

$$W_J = max.(W'_j)$$

The derived demand function for utilization of a given ICDS service is given by:

$$U_j = U\left(I, C_j, P_F, P_G, P_{IH}, X\right), \quad j \in \{0, \ldots, M - K\} \qquad \ldots(5)$$

The reduced form of health outcome (anthropometric) equation, conditional on the utilization of the $j^{th}$ service can then be written as

$$H^i_{|U^c_j} = H^i\left(I - C_j, P_F, P_G, P_{IH}, X\middle|U_j\right), \quad i = p, c \qquad \ldots(6)$$

We empirically estimate the utilization demand function and health outcome equation in the following section.

## 4. Sampling design and Summary statistics

### 4.1 Sampling Design

Data for this study was collected through a special-purpose survey administered as an additional module to the main Village Dynamics of South Asia (VDSA) survey of International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), in 11 villages

of 3 East Indian states – Bihar, Jharkhand and Orissa, in September-October, 2012.[14] The additional module was funded by the Field Research Fellowship Grant of the VDSA project, ICRISAT.[15]

VDSA employs a multi-stage stratification design. All districts in each state were ranked based on developmental indicators. Based on this, districts were then divided into 2 categories according to level of development – high and low. A district was then randomly chosen from each of the two categories. Within each chosen district, a block, and then 2 villages from each block were randomly selected. Households in the villages were then divided into 4 strata based on land size owned – landless, marginal, medium and large landholders. Ten households were randomly selected from each land category.

The survey for this study was conducted in a subset of the VDSA sample households — comprising households which had children in the age group 0-6 years. All the children in the reference age group in a household were surveyed. Thus, this survey canvassed information for 304 children belonging to 200 households of the 440 households surveyed in 11 villages. The distribution across land categories of all VDSA sample households and VDSA sample households with young children is nearly identical. This is also true for distribution of all households and households with young children in the population (by land category). In other words, the ratio of sampled households to total number of households, in each land category, is nearly identical for both – all households and households with children. Thus the sub-sample of VDSA households with young children is representative of households with young children in the village.[16]

In addition, we also collected data from all 34 ICDS centres in these villages about the services available at these centres, frequency of availability and reasons for non-availability.

After excluding children who were surveyed but are not permanent residents of the village (11 children out of a total of 304 children surveyed), and observations with missing information (10 children out of a total of 304 children surveyed), the analysis of the ICDS utilization decision was done on a sample of 283 children.

A few more observations had to be excluded while estimating the impact of ICDS utilization on anthropometric outcomes as heights and weights could not be measured for an additional 47 and 12 children, respectively (these include outliers as well). These children were either not available or it was not possible to take measurement despite repeated visits. This leads to concerns about whether children for whom weight and height measurements have been taken are a biased subsample of all children; this issue is discussed in section 4.2.c.

[14] Though the VDSA survey is conducted in 4 villages in each state, we could not administer the additional module in one village in Orissa due to logistical issues.

[15] The questionnaire for the additional module is available on request.

[16] Since the survey was restricted to a sub-sample of the VDSA sample, it is important to ask whether the subsample was powered to detect differences in anthropometric outcomes. It turns out that our sample is sufficient to detect a difference of 0.5 standard deviations in WAZ and HAZ scores with the probability of a type 1 error being 10 percent.

## 4.2. Summary statistics

### *4.2.a Households' perception of availability in contrast to centre reported availability of ICDS services*

A precondition to the decision of participating in the program and choosing which ICDS services to utilize is their availability. To check if there are adequate number of ICDS centres, we calculate the number of ICDS centres that should be operational in the sample villages using the population norm for each of the three survey states from PEO (2011) and find that there are state level differences.[17] While all villages in Jharkhand have more than required number of working ICDS centres, one village in Orissa and three in Bihar were short by a centre each.

However, the existence of an ICDS centre need not imply that all services are being provided. Using the data collected from ICDS centres, we find that except for health investment services at one of the 34 centres, both nutrition and health investment component were available at all centres.[18] We refer to this as "centre level availability". Since it is plausible that ICDS workers might have over-reported availability, we use household responses to validate the data provided by centres. We define a service as being available at a centre if there are at least 2 households which report availing that service from the centre. Using this alternative definition, we find that household responses match the responses of the ICDS worker, and that availability per se appears not to be a constraint.

However, the *perception* of availability also matters to utilization decisions. A household can only choose to consume an alternative from the set of choices that it perceives to be available, even if de facto a larger set is available at the centre. It is important to account for these beliefs to actually understand the drivers of demand for ICDS services.

One of the explanations for the gap between perceived availability and actual availability could be lack of awareness about the availability and/or entitlement. PEO (2011) finds that awareness about the program is low among households: two-thirds of the households did not know of their entitlements. In our sample, 12 percent of the households who did not participate in the ICDS program report that they were not aware about the program. These households, which mostly belonged to landless and marginal land class, might have participated had they been aware about the program.

Another factor that may affect perception of availability is social discrimination. CIRCUS (2006) finds that ICDS workers often deliberately leave out those households that

[17] The placement of an *anganwadi* centre is determined by a population norm of one *anganwadi* centre per 400-800 people in rural/urban areas and per 300-800 people in tribal areas. There are state level differences. Refer to PEO (2011) for norms each state.

[18] One centre in Bihar did not provide health investment services.

are of castes considered lower than their own during door-to-door visits and thus, such households may not be aware of their entitlements.[19]

To quantify household perceptions of availability, we canvassed a module on utilization of each of the ICDS services and the reasons for not utilizing them. Using these responses, a service is said to be unavailable if the household reports non-availability as the reason for non-utilization. We distinguish between reasons that depict actual or perceived unavailability from those that reflect conscious decision. For instance, a household reporting not utilizing a service because they do not need it would be defined as having access to that service. On the contrary, for a household which reports that a particular service is not provided at the centre, while we find other households in the sample availing that service from the centre, we say that the household does not perceive it to be available.[20]

It is clear that going by the ICDS worker's perceptions, as captured in "centre level availability", there is adequate supply of ICDS services (Table 3). The nutrition component is available to all the survey households and health investment component is not available to only 1 percent of them (after accounting for differences due to age-specific eligibility).

Table 3: Summary statistics on availability and utilization

| Variables | Mean | Standard Error |
|---|---|---|
| **Center level availability (% of households with access to)** | | |
| None of the services | - | - |
| Only nutrition and not investment service | 1.06 | 0.61 |
| Only investment and not nutrition service | - | - |
| Both nutrition and investment services | 98.94 | 0.61 |
| Number of observations | 283 | |
| | | |
| **Household perceived availability (% of households with access to)** | | |
| None of the services | 9.19 | 1.72 |
| Only nutrition and not investment service | 11.31 | 1.88 |
| Only investment and not nutrition service | 8.48 | 1.66 |
| Both nutrition and investment services | 71.02 | 2.70 |
| Number of observations | 283 | |
| | | |
| **Utilization of ICDS (%of households utilizing)** | | |
| None of the services | 41.59 | 4.86 |
| Only nutrition service | 18.01 | 4.31 |
| Only investment service | 18.60 | 3.34 |
| Both services | 21.80 | 2.93 |
| Number of observations | 283 | |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

[19] These visits are meant to spread awareness about the program and its components. The ICDS workers are supposed to inform households about the services being offered and persuade them to participate in the program. Services such as vaccination and health check-ups are provided in collaboration with other government health personnel, such as ANM, and are available only on particular days. During door-to-door visits, ICDS workers also inform households about the day and time at which these services shall be made available at the centre.

[20] The details on how we construct the measure of household perception are provided in Appendix A.1.

However, this is not true for "household perceived availability" with 9 percent of the households reporting no access to both nutrition and health investment services (Table 3). Of the remaining 91 percent, 11 percent do not have access to health investment service, and nutrition alternative is not available to 8 percent of the sample. For the parents of these children, the lack of utilization of ICDS services can hardly be a matter of choice. A comparison of households which perceive that they have fewer services available to them with the ones which perceive full availability shows that households with perception of no or limited supply are located near ICDS centres, and are more likely to be Scheduled Caste (SC) and landless (Table 4).[21] This is indicative of social exclusion in access to ICDS services, which we also find to be an important factor determining level of participation in ICDS program (discussed in section 5.2).

*4.2.b Utilization of ICDS services*

Though at least one alternative is perceived to be available by 91 percent of the sample, slightly less than 60 percent choose to participate in the program, with almost equal distribution across three alternatives (Table 3). Among the households that perceive availability of both ICDS services, less than half (45%) utilize both the services. About a quarter choose to participate partially, while 31 percent did not participate at all, suggesting that utilization of ICDS is affected by not only perceptions of supply, but demand factors also play an important role.

One such factor is access costs (Table 5). As noted earlier, households located farther away from the *anganwadi* centre are likely to face higher access costs than those living closer. This is perhaps reflected in a difference of more than 300 metres in the average distance to the ICDS centre between ICDS participants and non-participants.[22]

Another component of access costs could be the opportunity cost of the labour income foregone by mothers/parents bringing their children to the ICDS centre, although ICDS centre may also facilitate mother's labour force participation by providing day care services and making health services available in the village.[23] The share of working mothers among non-participants is significantly higher than among participants, suggesting that relatively higher opportunity cost of working mothers' time might decrease the likelihood of participation.

The third aspect of costs is social, as discussed before: 30 percent of SC children report facing some form of caste based discrimination in Mid-Day Meal Scheme (Sabharwal et al., 2014 (a)), and SC mothers have lower access to health services provided under Janani Suraksha Yojana, as compared to mothers from "other" caste category (Sabharwal et al., 2014 (b)). In our sample, the proportion of ST households among those who utilize ICDS

[21] We classify households in four caste categories – scheduled caste (SC), scheduled tribe (ST), backward castes (BC), and others, as per the Gazette of India (Ministry of Social Justice and Empowerment). These caste category names are as used in the Gazette of India.

[22] While the average distance to an ICDS centre does not seem to be too long, but for a 4 year child who has to walk to ICDS centre on uneven roads, even 500 metres might be a long distance.

[23] In our sample, however, mothers of very young children typically did not work outside home; the labour force participation rate of mothers was only 15 percent.

Table 4: Comparing households that perceive availability of all services with households that believe no or limited availability of ICDS services

| Variables | Full availability | No/limited availability | Difference |
|---|---|---|---|
| Number of observations | 201 | 82 | |
| Proportion of sample (%) | 71.02 | 28.98 | |
| Distance to ICDS center | 441.06 | 232.99 | 208.07*** |
| (meters) | (56.30) | (46.90) | (73.12) |
| Scheduled Caste (%) | 18.32 | 51.21 | -32.89*** |
| | (4.13) | (9.00) | (9.90) |
| Scheduled Tribe (%) | 22.84 | 9.81 | 13.03** |
| | (4.19) | (3.04) | (5.18) |
| Backward | 46.32 | 29.45 | 16.87* |
| Caste (%) | (4.85) | (7.85) | (9.23) |
| Other Caste (%) | 12.51 | 9.59 | 2.98 |
| | (2.64) | (3.74) | (4.58) |
| Land less household (%) | 48.39 | 65.57 | -17.18** |
| | (4.96) | (6.98) | (8.56) |
| Marginal land holding (%) | 18.95 | 14.33 | 4.62 |
| | (3.05) | (4.33) | (5.30) |
| Medium land holding (%) | 16.19 | 8.85 | 7.34* |
| | (2.67) | (2.63) | (3.75) |
| Large land holding (%) | 16.46 | 11.24 | 5.22 |
| | (2.66) | (3.31) | (4.25) |
| Mother's age (years) | 27.73 | 30.53 | -2.80** |
| | (0.61) | (1.19) | (1.33) |
| Bihar (%) | 38.09 | 82.19 | -44.09*** |
| | (4.98) | (4.43) | (6.67) |
| Jharkhand (%) | 35.89 | 10.68 | 25.21*** |
| | (4.54) | (3.16) | (5.53) |
| Orissa (%) | 26.01 | 7.13 | 18.88*** |
| | (3.94) | (2.66) | (4.76) |

Sources: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.
Notes: Differences in mean was insignificant for age of the child, sex, birth order, morbidity, whether utilized ICDS in past three months, mother's working status, father's age, parent's education and assets owned.
Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.

services is significantly higher than those who do not, and might lead one to believe that marginalized caste groups are not getting excluded from ICDS utilization (Table 5). However, if we compare across caste categories, then we find that the highest non-participation rates are among the SC households (53 percent) (Table 6). Among the participating households, a higher percentage of SC households choose to utilize only nutrition services, while a higher proportion of all the other three caste categories utilize comprehensive alterative. As mentioned before, SC households are also more likely to have a lower perception of availability of services.

Another way in which caste discrimination may affect ICDS participation is the caste of the *anganwadi* worker (AWW); an AWW may dissuade children from households that are

from lower castes (according to social hierarchy) than hers to come to the centre, or may discriminate against them while providing services. In the context of other interventions, such as the Public Distribution System, literature suggests that belonging to the same caste as the

Table 5: Summary statistics for the sample and by ICDS participation

| Variables | Full sample | ICDS participants | Non participants | Difference |
|---|---|---|---|---|
| Number of observations | 283 | 188 | 95 | |
| Proportion of sample (%) | 100.00 | 66.43 | 33.57 | |
| Distance to ICDS | 352.16 | 213.57 | 546.85 | -333.28*** |
| center (meters) | (40.32) | (27.94) | (86.16) | (90.28) |
| Working mother (%) | 14.69 | 6.22 | 26.58 | -20.36** |
| | (4.42) | (2.20) | (9.09) | (9.32) |
| Scheduled Caste (%) | 32.37 | 26.12 | 41.16 | -15.03 |
| | (5.18) | (5.66) | (8.91) | (10.53) |
| Scheduled Tribe (%) | 17.28 | 23.26 | 8.86 | 14.40*** |
| | (2.94) | (4.40) | (2.83) | (5.22) |
| Backward | 39.11 | 40.03 | 37.82 | 2.21 |
| Caste (%) | (4.50) | (5.62) | (7.35) | (9.22) |
| Other Caste (%) | 11.24 | 10.58 | 12.16 | -1.58 |
| | (2.22) | (2.66) | (3.87) | (4.68) |
| Same caste as ICDS | 58.02 | 68.55 | 43.22 | 25.34*** |
| worker (%) | (4.76) | (4.71) | (7.88) | (9.16) |
| Age of the child | 39.00 | 37.73 | 40.78 | -3.05 |
| (months) | (1.58) | (2.10) | (2.49) | (3.25) |
| Male (%) | 45.70 | 43.28 | 49.10 | -5.82 |
| | (4.71) | (5.39) | (8.25) | (9.83) |
| Mother's age (years) | 28.93 | 28.71 | 29.22 | -0.51 |
| | (0.67) | (0.77) | (1.17) | (1.40) |
| Mother's education | 3.63 | 4.05 | 3.05 | 1.00 |
| (years) | (0.41) | (0.53) | (0.59) | (0.79) |
| Mother's height (cm) | 150.38 | 150.87 | 149.68 | 1.19 |
| | (0.53) | (0.54) | (0.98) | (1.12) |
| Father's age (years) | 33.34 | 33.23 | 33.49 | -0.26 |
| | (0.68) | (0.79) | (1.22) | (1.44) |
| Father's education | 6.33 | 6.30 | 6.39 | -0.09 |
| (years) | (0.45) | (0.52) | (0.82) | (0.96) |
| Number of children | 2.41 | 2.43 | 2.39 | 0.04 |
| in house | (0.07) | (0.09) | (0.11) | (0.14) |
| Asset owned[#] | 0.80 | 0.78 | 0.83 | -0.05 |
| | (0.06) | (0.07) | (0.12) | (0.14) |
| Bihar (%) | 56.93 | 37.32 | 84.48 | -47.17*** |
| | (4.42) | (6.27) | (3.87) | (7.35) |
| Jharkhand (%) | 25.12 | 35.96 | 9.89 | 26.07*** |
| | (3.37) | (5.01) | (2.95) | (5.81) |
| Orissa (%) | 17.95 | 26.72 | 5.62 | 21.10*** |
| | (2.77) | (4.29) | (2.23) | (4.82) |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] - an index for number of assets owned constructed using PCA.

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

shop owner was a significant predictor of uptake (Thorat et al., 2008). There is evidence to suggest that similar social access costs may be at work even in the ICDS program as well. Among households that are attached to ICDS centres run by same caste AWW, 70 percent chose to participate in the program.

Table 6: Percentage of households utilizing ICDS services, by caste category (%)

| % Households | Scheduled Caste (SC) | Scheduled Tribe (ST) | Backward Caste (BC) | Other Caste |
|---|---|---|---|---|
| None of the services | 52.87 | 21.34 | 40.21 | 45.01 |
| | (10.61) | (6.11) | (6.62) | (9.91) |
| Only nutrition and not investment service | 25.02 | 9.86 | 18.85 | 7.40 |
| | (9.22) | (4.10) | (7.46) | (3.78) |
| Only investment and not nutrition service | 16.08 | 32.78 | 14.70 | 17.65 |
| | (6.21) | (9.95) | (3.75) | (6.76) |
| Both nutrition and investment services | 6.03 | 36.02 | 26.23 | 29.94 |
| | (2.66) | (7.29) | (4.97) | (9.21) |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.
Standard error in parentheses.

In addition to economic and social costs, there may be other factors influencing uptake. These may include gender of the child, mother's education and household wealth. In these respects, the summary statistics indicate no significant differences between ICDS participants and non-participants (Table 5). Other variables such as number of children, mother's health status (measured by mother's height), mother's age and father's education, which have also been found to affect participation in comprehensive programs elsewhere, there was no significant difference in the unconditional means among participants and non-participants.

*4.2.c Missing data on anthropometric outcomes*

As mentioned before, heights and weights could not be measured for 47 and 12 children, respectively. To ensure that this does not bias our results, we compare the children with missing anthropometric data with the ones with complete information and find that children with missing anthropometric data are different from the rest in some respects (Table 7). Children with missing data on weight have more educated parents, belong to richer families, more likely to belong to backward caste (BC) category and less likely to belong to landless class. For child height, the children with missing data are, on an average, younger by 13 months, have younger parents, more educated mothers and more likely to belong to BC category (Table 8).[24] Thus our sample consists of children who are weaker than average (have lower than average z-scores). This might lead to higher estimates of impact. Since these data are clearly not missing at random (Cameron and Trivedi 2005), the entire analysis of section 6 is repeated on the full sample, making the assumption that all the children with

[24] There were no statistically significant difference for the gender, birth order and morbidity of the child, and percentage of working mother between observations with missing data and the ones with complete information.

missing anthropometric data had a z-score of -1, -0.5 and 0 (as they are more likely to be healthy) and is discussed in section 6.2.

Table 7: Comparing observations with missing data on child weight to rest of the sample

| Variables | Data available | Data missing | Difference |
|---|---|---|---|
| Number of observations | 271 | 12 | |
| Proportion of sample (%) | 95.76 | 4.24 | |
| Age of the child (months) | 38.71 | 47.89 | -9.18 |
| | (1.62) | (6.24) | (6.20) |
| ICDS visit in past three | 58.40 | 58.84 | -0.44 |
| months (%) | (5.00) | (15.96) | (16.10) |
| Distance to ICDS center | 353.29 | 318.23 | 35.06 |
| (meters) | (41.64) | (54.28) | (66.66) |
| Mother's age (years) | 28.98 | 27.45 | 1.53 |
| | (0.69) | (0.81) | (1.03) |
| Mother's education | 3.53 | 6.83 | -3.30* |
| (years) | (0.42) | (1.95) | (1.91) |
| Father's age (years) | 33.41 | 31.12 | 2.29** |
| | (0.70) | (0.85) | (1.07) |
| Father's education (years) | 6.21 | 10.08 | -3.87** |
| | (0.46) | (1.61) | (1.61) |
| Asset owned[#] | 0.75 | 2.33 | -1.58*** |
| | (0.06) | (0.37) | (0.36) |
| Scheduled Caste (%) | 33.21 | 7.02 | 26.19*** |
| | (5.30) | (7.17) | (8.69) |
| Scheduled Tribe (%) | 17.71 | 4.30 | 13.41** |
| | (3.04) | (4.52) | (5.29) |
| Backward | 37.99 | 73.04 | -35.05*** |
| Caste (%) | (4.59) | (12.45) | (12.79) |
| Other Caste (%) | 11.09 | 15.64 | -4.55 |
| | (2.28) | (9.50) | (9.39) |
| Land less household (%) | 57.35 | 7.02 | 50.33*** |
| | (4.41) | (7.17) | (8.17) |
| Marginal land holding (%) | 15.98 | 47.13 | -31.15* |
| | (2.56) | (16.49) | (16.03) |
| Medium land holding (%) | 12.92 | 17.35 | -4.43 |
| | (2.00) | (12.97) | (12.60) |
| Large land holding (%) | 13.76 | 28.50 | -14.74 |
| | (2.15) | (13.60) | (13.22) |
| Bihar (%) | 56.35 | 74.44 | -18.09 |
| | (4.57) | (13.02) | (13.30) |
| Jharkhand (%) | 25.58 | 11.32 | 14.26 |
| | (3.48) | (8.42) | (8.79) |
| Orissa (%) | 18.07 | 14.24 | 3.83 |
| | (2.85) | (10.69) | (10.64) |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – an index for number of assets owned constructed using PCA.

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

Table 8: Comparing observations with missing data on child height to rest of the sample

| Variables | Data available | Data Missing | Difference |
|---|---|---|---|
| Number of observations | 241 | 42 | |
| Percentage of total sample | 85.16 | 14.84 | |
| Age of the child (months) | 40.94 | 27.45 | 13.49*** |
| | (1.71) | (3.26) | (3.65) |
| ICDS visit in past three | 57.83 | 61.86 | -4.03 |
| months (%) | (5.45) | (9.49) | (10.86) |
| Distance to ICDS center | 342.13 | 411.78 | -69.65 |
| (meters) | (41.96) | (122.68) | (128.47) |
| Mother's age (years) | 29.56 | 25.17 | 4.39*** |
| | (0.72) | (1.06) | (1.27) |
| Mother's education | 3.21 | 6.17 | -2.96*** |
| (years) | (0.44) | (0.99) | (1.07) |
| Father's age (years) | 33.81 | 30.57 | 3.24** |
| | (0.75) | (1.11) | (1.33) |
| Father's education (years) | 6.16 | 7.37 | -1.21 |
| | (0.50) | (0.87) | (1.00) |
| Asset owned[#] | 0.76 | 1.05 | -0.29 |
| | (0.07) | (0.19) | (0.19) |
| Scheduled Caste (%) | 34.62 | 19.05 | 15.57* |
| | (5.81) | (7.15) | (9.15) |
| Scheduled Tribe (%) | 17.24 | 17.47 | -0.23 |
| | (3.23) | (6.88) | (7.53) |
| Backward | 36.49 | 54.68 | -18.19* |
| Caste (%) | (4.94) | (9.08) | (10.25) |
| Other Caste (%) | 11.65 | 8.80 | 2.85 |
| | (2.53) | (3.61) | (4.38) |
| Land less household (%) | 56.41 | 51.71 | 4.70 |
| | (4.88) | (9.13) | (10.27) |
| Marginal land holding (%) | 17.06 | 16.50 | 0.56 |
| | (2.86) | (6.15) | (6.72) |
| Medium land holding (%) | 12.23 | 17.97 | -5.74 |
| | (2.06) | (5.95) | (6.24) |
| Large land holding (%) | 14.30 | 13.82 | 0.48 |
| | (2.35) | (5.24) | (5.69) |
| Bihar (%) | 58.97 | 44.82 | 14.15 |
| | (4.82) | (9.41) | (10.49) |
| Jharkhand (%) | 26.45 | 17.21 | 9.24 |
| | (3.82) | (6.74) | (7.69) |
| Orissa (%) | 14.58 | 37.96 | -23.38*** |
| | (2.78) | (8.47) | (8.83) |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.
Notes: [#] – an index for number of assets owned constructed using PCA.
Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.

### *4.2.d Summary statistics on anthropometric outcomes*

There is high prevalence of malnourishment in our sample, with 51 percent of children being underweight, and 48 percent being stunted (Table 9). The HUNGaMA survey report (2011) finds a lower underweight prevalence of 42 percent, but a higher prevalence of

stunting (59 percent). There is no significant difference in WAZ and HAZ scores and prevalence rates of underweight and stunting between ICDS participants and non-participants. However, the average WAZ scores are significantly lower among the households that choose to utilize all ICDS services (comprehensive alternative) (-1.54) as compared to those who utilize only nutrition services (-1.93), or those who do not participate at all (-2.16) (Appendix Table A.1). Similarly, stunting rates are highest among the households that utilize only health investment services (65%).

Table 9: Summary statistics for health outcomes for the sample, and by ICDS participation

| Variables | Full sample | ICDS participants | Non participants | Difference |
|---|---|---|---|---|
| Weight-related outcomes | | | | |
| Number of observations | 271 | 184 | 87 | |
| Proportion of sample | 100.00 | 67.90 | 32.10 | |
| Underweight (%) | 51.16 | 44.44 | 60.33 | 15.89 |
| | (4.91) | (5.48) | (7.94) | (9.65) |
| Weight (kg) | 11.34 | 11.30 | 11.40 | -0.10 |
| | (0.25) | (0.33) | (0.40) | (0.51) |
| Weight-for-age z-scores | -1.97 | -1.83 | -2.16 | 0.33 |
| | (0.10) | (0.14) | (0.16) | (0.21) |
| Height-related outcomes | | | | |
| Number of observations | 241 | 161 | 80 | |
| Proportion of sample | 100.00 | 66.80 | 33.20 | |
| Stunted (%) | 48.31 | 52.70 | 42.28 | 10.42 |
| | (5.32) | (6.57) | (8.74) | (10.93) |
| Height (cm) | 89.79 | 89.05 | 90.80 | -1.75 |
| | (1.12) | (1.50) | (1.72) | (2.28) |
| Height-for-age z-scores | -1.85 | -1.91 | -1.78 | -0.13 |
| | (0.15) | (0.18) | (0.26) | (0.32) |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.
Standard error in parentheses; ***, ** and * indicate significance at 1, 5 and 10 percent respectively.

The summary statistics reported in section 4.2.b suggest that the participation in ICDS program is not random, and is dependent on individual and household characteristics. These characteristics not only affect participation decision but can also affect health outcomes. Thus, a simple comparison of outcomes of participants and non-participants will give biased estimates of the impact of program participation. Also, if there are other factors that independently affect health outcomes, but not participation, then not accounting for such factors will also confound our estimates of impact of utilization of ICDS services on anthropometric outcomes. Therefore we compare other such factors that may affect health outcomes, but not ICDS participation. We consider a hedonic ranking of size at birth, morbidity, dietary diversity score which is an indicator for dietary quality, number of vaccinations taken, household size, sanitation and drinking water facility available at home,

and type of fuel used.[25] However, we do not find any significant differences between participants and non-participants apart from number of vaccinations received and access to safe drinking water. Participants have received higher number of vaccinations as compared to non-participants but since vaccination is a part of the ICDS program, it is not unexpected. Thus, the differences in the factors that affect ICDS utilization (leading to self-selection in the program) and health outcomes (independent of ICDS utilization) need to be accounted for while estimating the impact of ICDS utilization on health outcomes.

## 5. Utilization of ICDS services

To model the choice of a household regarding the decision and level of participation in ICDS program, we estimate equation (5).

### 5.1. Estimation Method – Multinomial Logistic Models

The participation decision is best modeled as a discrete choice among the four alternatives, with the underlying assumption being that an individual derives utility from each of the alternative and chooses the alternative that gives her/him most utility.

These choices may be modeled using Multinomial Logistic Model (MNL).[26] The standard version of the model assumes that the same choice set is available to all individuals. Since in our case the number of choices available to an individual varies depending on age-specific eligibility, supply and perception, we therefore estimate the utilization decision using a *varying choice set MNL* proposed by Yamamoto (2011). If $S_{im}$ is the set of alternatives available to an individual from all alternatives, then the probability of choosing an alternative *j* by an individual *i* can then be written as

$$\Pr(U_{ij}) = \frac{\exp(V_{ij})}{\sum_{m \in S_{im}} \exp(V_{im})}$$

where $V_{ij}$ is the observed systematic component of the utility derived from consuming alternative *j* and depends on the characteristics of alternative *j* and of individual *i*. The above expression is arrived at by assuming that the stochastic component of the utility derived from consumption of alternative *j* follows a logistic distribution. The above equation is same as a standard MNL model, the only difference being in the denominator. While in a MNL model, summation is over all choices and remains same for all the households, in the above expression, summation is over choices that the household is eligible for and perceives as being available. In our sample, a tenth of the households are not included in the estimates as they do not perceive that they have access to any ICDS service and therefore have no choice of participating. And one fifth of the household have only two choices in their choice set as at

[25] Size at birth was measured using a 5 point hedonic scale, with 1 implying very large and 5 implying very small. Dietary diversity score is the number of different food items consumed by child in a week preceding the survey; this was constructed using food frequency data. The results are presented in Appendix Table A.2.

[26] Refer to Train (2009) for details on Multinomial Logistic models.

least one of the nutrition or health investment alternative is not available to them (after accounting for differences in eligibility).

The systematic component of the utility from the $j^{th}$ choice to individual $i$ ($V_{ij}$) is modelled as:

$$V_{ij} = \alpha_j + \beta_j W_{ij}$$

where $\alpha_j$ is the alternative specific constant and $W_{ij}$ is a vector of household characteristics.[27] Following the preceding discussion, $W_{ij}$ includes measures of economic access (distance from household $i$ to the ICDS centre and whether the mother works outside the home), social access (dummy for caste categories and a dummy variable taking value 1 if the household belongs to same caste as AWW), child characteristics (age, dummy variable for boys and birth order), parental characteristics (age and education), and household characteristics (number of children in the household and an index for number of assets owned by a household constructed using Principal Component Analysis).[28] We also control for state fixed effects.[29]

## 5.2. Results

Results from multinomial logit estimation of utilization decision using household perceived availability are presented in Table 10 (marginal effects).[30] Marginal effects measure the change in probability of choosing a particular alternative for a unit change in covariate.[31] These results should be interpreted as being conditional on household reporting that alternative to be available.

First, consider the effect of economic cost of utilizing ICDS services on household's choice of participating in the program. Our results suggest that longer distances make it costly for the household to participate in the ICDS program and therefore reduce the probability of participation across all alternatives. The highest marginal effect is observed for the comprehensive alternative, where a 100 metres increase in distance to the centre reduces the probability of utilizing this alternative by 2.3 percentage points.

In our sample, we find that since the ICDS helper accompanies children to the centre, availing ICDS services does not compete with mother's time spent in labour market. In fact it seems to provide a convenient alternative to visiting nearest public health care centre to avail health investment services as working mothers are more likely to utilize the health investment alternative.

[27] Estimation of a MNL model requires including variables that vary by alternative. Since the variables considered in this model are not alternative, but individual and household specific, we multiply each variable with alternative specific constant.

[28] These include ownership of farm implements, livestock and consumer durables.

[29] We do not include prices of food, non-food goods and health investments as there was not much variation in these variables at the village level. Also, the village dummies were highly correlated with other covariates and therefore are not included in our model.

[30] These are computed as the average of marginal effects for each individual. Beta coefficients are presented in Appendix Table A.3.

[31] The sum of marginal effects, across all alternatives, for a covariate is zero.

Table 10: Multinomial Logistic model estimates for utilization of ICDS services conditional on household perception of availability (marginal effects)

| Variables | Nutrition service | | Investment service | | Both services | | None of the service | |
|---|---|---|---|---|---|---|---|---|
| Percentage of total sample | 13.65 | | 22.89 | | 36.55 | | 26.91 | |
| Distance to AWC (’00 meter) | -0.011*** | (0.002) | -0.013*** | (0.002) | -0.023*** | (0.002) | 0.048*** | (0.003) |
| Dummy for working mother | 0.024*** | (0.005) | 0.066*** | (0.007) | 0.046*** | (0.007) | -0.136*** | (0.010) |
| Caste – SC | -0.046*** | (0.013) | -0.091*** | (0.014) | -0.171*** | (0.017) | 0.308*** | (0.023) |
| Caste – ST | 0.019* | (0.011) | -0.202*** | (0.020) | -0.108*** | (0.019) | 0.290*** | (0.023) |
| Caste – BC | -0.145*** | (0.013) | -0.047*** | (0.005) | 0.046*** | (0.007) | 0.147*** | (0.012) |
| Dummy for same caste as AWW | 0.108*** | (0.009) | -0.033*** | (0.004) | -0.000 | (0.006) | -0.074*** | (0.008) |
| Assets owned[#] | 0.039*** | (0.003) | -0.065*** | (0.005) | 0.002 | (0.005) | 0.024*** | (0.004) |
| Male Dummy | -0.022*** | (0.003) | -0.033*** | (0.003) | 0.002 | (0.003) | 0.053*** | (0.004) |
| Age (in months) | 0.002*** | (0.000) | -0.012*** | (0.001) | 0.004*** | (0.001) | 0.005*** | (0.001) |
| Birth Order[##] | 0.041*** | (0.003) | -0.031*** | (0.003) | 0.008*** | (0.003) | -0.018*** | (0.003) |
| Mother's age (years) | -0.035*** | (0.003) | 0.006*** | (0.001) | -0.011*** | (0.002) | 0.040*** | (0.003) |
| Mother's education (years) | 0.013*** | (0.001) | -0.005*** | (0.001) | -0.009*** | (0.001) | 0.002* | (0.001) |
| Mother's height (cm) | -0.009*** | (0.001) | 0.000** | (0.000) | 0.002*** | (0.000) | 0.006*** | (0.001) |
| Father's age (years) | 0.028*** | (0.003) | -0.002 | (0.002) | 0.019*** | (0.002) | -0.045*** | (0.003) |
| Father's education (years) | -0.020*** | (0.002) | -0.008*** | (0.001) | 0.007*** | (0.001) | 0.022*** | (0.002) |
| Number of children | 0.053*** | (0.005) | 0.022*** | (0.003) | 0.012*** | (0.004) | -0.087*** | (0.007) |
| Jharkhand | -0.239*** | (0.023) | 0.121*** | (0.021) | 0.393*** | (0.032) | -0.275*** | (0.029) |
| Orissa | -0.187*** | (0.017) | -0.030*** | (0.012) | 0.323*** | (0.022) | -0.106*** | (0.016) |
| Log likelihood | -4696.15 | | | | | | | |
| Number of observations | 249 | | | | | | | |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – an index for number of assets owned constructed using PCA, [##] – Birth order 1 is assigned to first born child, and an increasing value is assigned to subsequently born children.

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

The effect of social access cost on probability of participating outweighs that of economic cost. Compared to "other" caste category households, SC households are more likely to not participate in the program. This is true for ST households as well, who are also more likely to not use any of the services. In terms of ICDS utilization, SC households are least likely to utilize the comprehensive alternative, while for ST households the probability is lowest for health investment alternative. BC households fare better; though this caste group is also less likely to avail of ICDS services as compared to "other" caste, the probability of not participating (14.7) is not as high as for SC and ST households. Also among all ICDS alternatives, BC households have a positive probability of choosing the comprehensive alternative. Thus this caste group, when it chooses to participate, is more likely to use all services of ICDS.

Another variable capturing social cost is whether the household belongs to same caste category as the AWW. If both the household and AWW belong to same caste category, then it increases the probability of participating in ICDS by 7.4 percentage points. It increases the probability of choosing nutrition alternative the most. There is no effect on comprehensive alternative and negative effect on uptake of health investment alternative. Caste discrimination may well be more pronounced in ICDS services which include food distribution, as this requires direct contact with the AWW, therefore high and positive effect of AWW's caste category on uptake of supplementary nutrition component is not unexpected. The negative marginal effect of health investment alternative should be interpreted with caution. The beta coefficients, which can be interpreted as log of odds ratio, for all three alternatives nutrition, health investment and both (comprehensive), are positive, though insignificant for health investment alternative (Appendix Table A.3). That is, a household is as likely to choose health investment alternative as it is to not participate in the program. The negative marginal effect for health investment implies that households not belonging to the same caste as ICDS worker are more likely to choose health investment bundle over nutrition bundle.[32]

Another important factor that adversely affects ICDS utilization is the economic status of the household, as measured by number of assets owned. Improvement in economic status of the household reduces the probability of participating in ICDS program by 2.4 percentage points. This is as expected. However among participants, higher economic status translates into a higher probability of selecting the nutrition component. This is not expected and may

[32] One may argue that both caste dummies and same caste dummy capture aspects of discrimination. We therefore estimate two alternative models, dropping one of the two variables at a time. The marginal effects from these alternative models are presented in Appendix Table A.4. (The marginal effects for other variables and the beta coefficients for these alterative models are not provided here. These can be made available on request). Dropping the dummy variable for same caste as AWW, makes the marginal effect for nutrition service for SC households insignificant and the direction of other results does not change, though the magnitudes are higher for nutrition and health investment service. Dropping caste dummies also does not change the direction of results. We also examine if belonging to same caste as the ICDS worker is more beneficial for marginalized and backward caste groups by including a dummy for belonging to same caste as AWW but only for SC, ST and BC category households (Model 4), and find that social access cost plays a stronger role for these households. (A better way to account for this would have been to include a dummy for belonging to same caste as AWW for each caste category. However none of the SC households that are catered by SC AWW opted for the comprehensive alternative, and thus leads to identification problem).

imply some crowding out of less wealthier households, especially as the number of households that can avail of nutrition component from an ICDS centre is fixed. Taken together, the marginal effects on social access cost and assets suggest that the ICDS program has not been able to attract/cover the socially and economically marginalized households.

The estimated marginal effects on the gender dummy suggests that girls are more likely to participate than boys, and are more likely to choose either nutrition or health investment alternative. Older children are more likely to avail of comprehensive bundle. This is expected as the children above 3 years are also eligible to avail preschool services from the ICDS centre and therefore, spend 4 hours at the centre every day. This reduces the access cost to avail other services and makes it easier to avail all components of the program. Higher birth order children, i.e. those born later, are less likely to participate in the program and if they do, they are more likely to choose comprehensive alternative.

State dummies capture high participation rates in Jharkhand and Orissa; these states also have higher rates of full utilization of all ICDS services.

The analysis thus far is based on choices made from among the set of alternatives that a household perceives to be available to them. How might results change if availability were defined based on what the centre reports? As discussed earlier, using the latter definition translates into virtually all services being available to everyone. Table 11 reports results from the MNL based on centre-reported availability. There are some changes in direction of signs of some coefficients. For example, the effect of belonging to same caste as AWW is opposite to the one we get after conditioning on household perception of availability, suggesting that the program is at least able to attract the marginalized caste groups to participate in the health investment component, if not in all services. Thus, not accounting for household perception of availability seems to under-estimate the role of social barriers. Similarly, marginal effects of economic status show high probability of participating in the nutrition component by the economically weaker section. Also, compared to results that condition on household perceived availability, the probability of richer households participating in any of the ICDS services is lower. Thus, not accounting for household perceptions gives an impression that the program's performance in targeting economically weak households is not as bad and marginalized caste categories are not being left out. There are differences in the signs of marginal effects for other covariates (such as age of child and parents' characteristics) as well. Therefore, it is important to account for differences between centre reported and household perceived availability to be able to channelize efforts in right direction. For example, results from centre reported availability suggests that targeting non-working mothers will increase participation rate in the program, which is opposite of the results we get when using household perceived availability.

From a statistical perspective, the two definitions of availability may be seen as two competing, but non-nested models. Using Vuong test for non-nested models (Greene 2003), we find that the household-perceived availability fits the data better. Therefore, we estimate the impact of ICDS participation on anthropometric outcomes in the next section using

Table 11: Multinomial Logistic model estimates for utilization of ICDS services conditional on center reported availability (marginal effects)

| Variables | Nutrition service | | Investment service | | Both services | | None of the service | |
|---|---|---|---|---|---|---|---|---|
| Percentage of total sample | 12.50 | | 20.96 | | 33.45 | | 33.09 | |
| Distance to AWC (’00 meter) | -0.011*** | (0.000) | -0.007*** | (0.000) | -0.015*** | (0.001) | 0.034*** | (0.001) |
| Dummy for working mother | -0.022*** | (0.002) | 0.043*** | (0.002) | -0.040*** | (0.002) | 0.018*** | (0.002) |
| Caste – SC | -0.023*** | (0.005) | 0.039*** | (0.004) | -0.194*** | (0.010) | 0.178*** | (0.008) |
| Caste – ST | -0.173*** | (0.013) | 0.100*** | (0.007) | -0.164*** | (0.013) | 0.237*** | (0.012) |
| Caste – BC | -0.068*** | (0.005) | -0.027*** | (0.002) | 0.038*** | (0.003) | 0.057*** | (0.003) |
| Dummy for same caste as AWW | -0.036*** | (0.003) | 0.088*** | (0.006) | 0.054*** | (0.004) | -0.105*** | (0.005) |
| Assets owned[#] | -0.051*** | (0.004) | 0.022*** | (0.001) | 0.025*** | (0.002) | 0.004** | (0.002) |
| Male Dummy | -0.018*** | (0.002) | -0.052*** | (0.003) | 0.051*** | (0.002) | 0.019*** | (0.003) |
| Age (in months) | -0.011*** | (0.001) | 0.002*** | (0.000) | 0.005*** | (0.001) | 0.004*** | (0.000) |
| Birth Order[##] | -0.037*** | (0.003) | 0.027*** | (0.002) | 0.060*** | (0.003) | -0.050*** | (0.003) |
| Mother's age (years) | 0.012*** | (0.001) | -0.005*** | (0.000) | 0.002*** | (0.001) | -0.009*** | (0.001) |
| Mother's education (years) | -0.009*** | (0.001) | 0.006*** | (0.000) | 0.001* | (0.000) | 0.002*** | (0.000) |
| Mother's height (cm) | -0.003*** | (0.000) | -0.002*** | (0.000) | 0.003*** | (0.000) | 0.001*** | (0.000) |
| Father's age (years) | -0.010*** | (0.001) | 0.001*** | (0.000) | -0.000 | (0.000) | 0.010*** | (0.000) |
| Father's education (years) | -0.003*** | (0.000) | -0.015*** | (0.001) | 0.002*** | (0.000) | 0.016*** | (0.001) |
| Number of children | 0.013*** | (0.001) | 0.028*** | (0.002) | -0.025*** | (0.001) | -0.016*** | (0.001) |
| Jharkhand | 0.077*** | (0.015) | -0.261*** | (0.016) | 0.558*** | (0.028) | -0.374*** | (0.023) |
| Orissa | -0.001 | (0.012) | -0.097*** | (0.009) | 0.500*** | (0.024) | -0.402*** | (0.019) |
| Log likelihood | -7897.43 | | | | | | | |
| Number of observations | 272 | | | | | | | |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – an index for number of assets owned constructed using PCA, [##] – Birth order 1 is assigned to first born child, and an increasing value is assigned to subsequently born children.

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

"household perceived availability" only.[33]

## 6. Impact of utilization on anthropometric outcomes

Now we turn to our second objective of the study which is to estimate the impact of utilizing ICDS services on anthropometric outcomes.

### 6.1. Covariate and Propensity Score Matching

The standard evaluation problem in attributing the impact of ICDS on heights and weights of children arises since ICDS participation is endogenous. When program participation is non-random, as is the case here, matching methods may be appropriate to estimate impact, provided the selection into the ICDS is based on observable characteristics. Matching methods create a counterfactual for each participant from the pool of non-participants, based on observables. The difference in outcomes of this matched counterfactual group and participants can give us the impact of ICDS on health outcomes.

There are various ways one can use to match the participants with non-participants. To create a group of counterfactuals, matching can be done on all covariates that distinguish participants from non-participants; this method is known as covariate matching (CVM). However, having a large number of covariates can lead to a problem of too many combinations and inability to find exact matches. This is called the "curse of dimensionality". Abadie and Imbens (2002) proposed a matching technique that resolves this problem. They suggest that instead of matching on all covariates, one can match on the distance between the covariates. The weighted average of a fixed number of closest neighbours, in terms of distance, is used as a counterfactual.

Another approach to matching is the propensity score matching (PSM) proposed by Rosenbaum and Rubin (1983), where matching is done on the propensity scores or the probability of participation. The estimated propensity score contains all the information of the covariates and reduces the problem of matching to a single dimension. The conditional independence assumption (CIA), that is treatment participation and treatment outcome are independent of each other, conditional on the covariate vector Z, is required to identify the treatment effect in both CVM and PSM methods.[34]

There is no consensus in literature about the performance of alternative matching methods. Busso et al. (2014) compare the performance of various matching estimators for finite samples using simulations and recommend that one should use various approaches to check robustness of results. Therefore, we present results using both PSM and CVM.

[33] The Vuong statistics for the non-nested hypothesis of household perceived availability vs. centre reported availability was 4.34, implying that model 1, that is, model with household perceived is availability favoured.

[34] CVM by Abadie and Imbens (2002) additionally assumes that the conditional mean and variance function (conditional on treatment) is continuous. Also, the fourth moment of conditional distribution of Y (conditional on treatment and covariate) exists and is bounded.

However, both these techniques were proposed to assess the impact of a single treatment. In our case, the interest is in examining the impact of each of the three alternatives. This can be addressed using the framework proposed by Imbens (2000) and Lechner (2001), who extended the PSM method proposed by Rosenbaum and Rubin (1983) to a multiple treatment framework (more than two alternatives). The identifiability assumption in multiple treatment case requires that outcomes in all treatments should be independent of treatment assignment, given certain observables *Z*. In other words, conditional on a vector of observables *Z*, anthropometric outcomes should be orthogonal to utilization of any of the ICDS components. If $H$ represents health outcome and $U \in \{0, \ldots, 3\}$ represents participation in a particular treatment, then the CIA can be written as:[35]

$$H^0, H^1, \ldots, H^3 \perp U|Z$$

The average treatment effect on treated (ATT) of alternative *m* relative to alternative *j* ($\theta^{mj}$) is given by the following equation.

$$\theta^{mj} = E\left(H^m - H^j \middle| U = m\right) = E(H^m|U = m) - E(H^j|U = m)$$

The expression $E(H^j|U = m)$ is the counterfactual which is not observed and is created by matching.

$$\theta^{mj} = E(H^m|U = m) - E_{P^{j|mj}(Z)}(E(H^j|P^{j|mj}(Z), U = j)|U = m)$$

$$where, \qquad P^{j|mj}(X) = P^{j|mj}(U = j|U = j \text{ or } m, Z) \qquad \ldots(a)$$

Equation (*a*) gives the probability of choosing alternative *j*, if *m* and *j* are the two choices available. The second equation is similar to a two treatment case.

These probabilities or the propensity scores which are used to generate the counterfactual could be estimated either using an MNL, or a series of bivariate logistical regressions (Lechner, 2001). Using estimates of propensity score from MNL has the advantage that it incorporates the interdependence of probabilities across different alternatives. Lechner (2002) compares these two alternative approaches to estimating the propensity score and finds that empirically the results from the two approaches are same.

Since there is no such multiple treatment extension for covariate matching, we report results for bivariate comparisons for both matching methods. Since matching methods such as nearest neighbour matching are discontinuous functions, standard asymptotic expansions cannot be used to derive the variance of these estimators.[36]Abadie and Imbens (2008) show that due to this reason, bootstrapped standard errors are also not correct for such matching methods. Abadie and Imbens (2006) provide an estimator for the analytical standard error for the asymptotic variance of matching estimators which is consistent. These are used here.

[35] 0 refers to not choosing any service, i.e. not participating in the ICDS program

[36]Abadie and Imbens (2006) note that despite being very commonly used to evaluate the impact of treatment, large sample properties of matching estimators have not been established. They show that nearest neighbour matching estimator is not root n consistent due to the bias term mentioned above.

To create the counterfactual group, whether by PSM or CVM, the covariates we use include various child-specific (age, gender, order, size at birth, whether the child was ill in last one month), parents-specific (age, education, mother's health status and labour market participation) and household-specific characteristics (distance to ICDS centre, whether the household belongs to same caste as ICDS worker, household size, economic status, caste category, access to clean drinking water, access to hygienic sanitation facility and type of fuel used for cooking). We also use state fixed effects.

To assess whether the counterfactual group thus created results in comparable sets of participants and non-participants, we use two tests. First we use a two sample t-test for differences in means for all covariates; after matching there should not be significant difference in means of the control and treatment group. Since there are a large number of such comparisons, Table 12 presents differences in the means of all covariates, for one such comparison where the treatment group refers to households utilizing any ICDS services, and control group refers to not participating in ICDS at all, we are relegating the remaining comparisons to Appendix Tables A.5 – A.7. For many of the covariates considered, while there are statistically significant differences in the means of unmatched covariates, these differences lose significance when matched means are compared.

The second measure that we use, tests the joint significance of all covariates (Caliendo and Kopeinig, 2008). This is done by re-estimating the propensity score equation for matched sample only and then comparing the Pseudo-$R^2$ before and after matching. The last column of Table 12 reports the Pseudo-$R^2$, before and after matching; the post matching Pseudo $R^2$ is low and insignificant, which is indicative of good matching quality. Thus, using both the criterions, we find that the distribution of observables is balanced after matching for each of our binary comparisons (of treatments).[37]

## 6.2. Impact on Anthropometric Outcomes using PSM and CVM

The impact of utilization of ICDS services on WAZ scores as estimated by both PSM and CVM is presented in Table 13 (Panel A). We first consider the impact of utilization of any of the ICDS services as compared to non-utilization. The unmatched differences suggest that there is no significant effect of utilization. However, results from both PSM and CVM method suggest a significant positive impact of approximately 0.44 standard deviations on WAZ. This implies an increase of 440 grams for an 18 month old child and 880 grams for a 39 month old child. This would also translate into a reduction in prevalence of underweight by 11 percentage points.

The increase in WAZ scores, estimated above, due to ICDS participation is not expected to be uniform for all children, as the number and type of services availed varies by households. To examine if impact estimates vary when intensity of participation is accounted for, Table 13 also presents the impact of utilizing both services, separately from the impact of

[37] For the comparison between full and partial utilization of ICDS services, the variable for the age of the child could not be balanced, which also affects the overall balancing of the model.

Table 12: Results for tests conducted to evaluate matching quality between households utilizing at least one ICDS service (treatment) and households not participating in ICDS program (control)

| Variables | Weight-for-age z-scores | | Height-for-age z-scores | |
|---|---|---|---|---|
| | Difference in means before matching[†] | Difference in means after matching[†] | Difference in means before matching[†] | Difference in means after matching[†] |
| Distance to ICDS center (meters) | -435.65*** | 56.91 | -409.30*** | 17.20 |
| Working mother (dummy) | -0.03 | 0.02 | -0.02 | 0.01 |
| Caste-SC (dummy) | 0.00 | 0.00 | 0.00 | -0.03 |
| Caste-ST (dummy) | 0.16** | 0.00 | 0.17** | 0.01 |
| Caste-BC (dummy) | -0.03 | -0.01 | 0.01 | -0.02 |
| Same caste as ICDS worker (dummy) | 0.20*** | -0.06 | 0.21*** | 0.00 |
| Asset owned[#] | -0.76** | -0.27 | -0.96*** | -0.43 |
| Male (dummy) | 0.03 | 0.07 | 0.02 | 0.03 |
| Age of the child (months) | -9.10*** | -0.17 | -9.00*** | -1.56 |
| Birth order[##] | 0.25 | -0.10 | 0.25 | -0.07 |
| Morbidity (dummy) | 0.18** | -0.02 | 0.17** | -0.02 |
| Size at birth[###] | -0.09 | -0.13 | -0.10 | -0.05 |
| Mother's age (years) | -0.05 | -0.30 | -0.42 | -0.38 |
| Mother's education (years) | -0.60 | -0.71 | -0.97 | -0.09 |
| Father's age (years) | 0.83 | -0.32 | 0.35 | 0.14 |
| Father's education (years) | -2.10*** | -1.06 | -2.26*** | -0.72 |
| Using clean fuel (dummy) | -0.10** | 0.04 | -0.11** | -0.01 |
| Land less household (dummy) | 0.00 | 0.05 | 0.02 | 0.00 |
| Marginal land holding (dummy) | -0.07 | -0.02 | -0.03 | 0.01 |
| Medium land holding (dummy) | 0.13** | 0.01 | 0.07 | 0.02 |
| Large land holding (dummy) | -0.06 | -0.04 | -0.06 | -0.03 |
| Bihar (dummy) | -0.47*** | -0.05 | -0.42*** | 0.03 |
| Jharkhand (dummy) | 0.34*** | 0.00 | 0.37*** | 0.02 |
| Orissa (dummy) | 0.13** | 0.05 | 0.05 | -0.05 |
| Pseudo-$R^2$ | 0.48*** | 0.06 | 0.45*** | 0.08 |
| Number of observations | 240 | | 215 | |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [†] - Difference in mean = Mean of treatment group – Mean of control group

[#] – an index for number of assets owned constructed using PCA, [##] – 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 large and 5 implying very small.

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

utilizing any one (but not both) of the ICDS services.[38] The impact of utilizing both services is almost similar to the impact of utilizing any one of the ICDS service, at 0.48-0.51 standard deviations. However, using only one of the services results in an impact of 0.15 standard deviations using PSM, but the CVM suggests no impact. A 0.15 standard deviation improvement in WAZ scores translates into an approximately 6 percentage points reduction in prevalence of underweight, a far lower magnitude than 11 percentage points reduction seen when both services are availed.

[38]As mentioned before, the sub-samples to evaluate the impact of each of nutrition and health investment alternatives independently were too small to permit estimation.

Table 13: Impact of ICDS participation on child weight and height, using different matching methods

| Comparisons | Unmatched differences | Propensity Score Matching | Covariate Matching | Number of Observations |
|---|---|---|---|---|
| | Impact of utilizing ICDS services on Weight-for-age z-scores (Panel A) | | | |
| ICDS participation[#] | 0.32 | 0.43*** | 0.45*** | 240 |
| vs. not participating | (0.28) | (0.03) | (0.19) | |
| Both services[###] | 0.51* | 0.48*** | 0.51** | 149 |
| vs. not participating | (0.31) | (0.03) | (0.23) | |
| Either service[##] | 0.17 | 0.15*** | 0.02 | 151 |
| vs. not participating | (0.31) | (0.03) | (0.23) | |
| Both services[###] | 0.34 | 0.41*** | 0.75*** | 136 |
| vs. either service[##] | (0.26) | (0.04) | (0.24) | |
| | Impact of utilizing ICDS services on Height-for-age z-scores (Panel B) | | | |
| ICDS participation[#] | -0.17 | 0.34*** | -0.46 | 215 |
| vs. not participating | (0.50) | (0.03) | (0.39) | |
| Both services[###] | 0.08 | 0.43*** | 0.55 | 134 |
| vs. not participating | (0.52) | (0.04) | (0.47) | |
| Either service[##] | -0.38 | 0.07 | -0.34 | 132 |
| vs. not participating | (0.56) | (0.05) | (0.54) | |
| Both services[###] | 0.46 | 0.34*** | 0.29 | 120 |
| vs. either service[##] | (0.40) | (0.05) | (0.30) | |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – ICDS participation implies utilizing at least one or both ICDS services, [##] – Either service implies utilizing either nutrition or investment service, [###] – Both services implies utilizing both nutrition and investment services

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

These magnitudes suggest that there are complementarities in the use of ICDS services – as using both services seems to have greater impact than using only one service (in either case, comparison is with children who do not participate at all). To verify if this is the case, we compute impact estimates using households who use both services as the treatment group, and those who use only one of the two services as the comparison group. If there were no complementarities in utilization, we would expect these impact estimates to be insignificant. The results presented in Table 13 however suggest that this is far from the case. Using an additional service has a higher impact (0.41-0.75 standard deviations), than just using one service on WAZ scores. This suggests that there are some threshold effects in ICDS utilization, and in order to realize the full potential of the program, all services must be utilized.

The results for HAZ scores are similar when PSM is used to estimate impact; all the CVM impact estimates are insignificant (Table 13. Panel B). The PSM results suggest that utilization of any ICDS service leads to an increase of 0.34 standard deviations in HAZ scores which is equivalent to reduction in the prevalence of stunting by 5 percentage points. In contrast, children who utilize both services experience a 0.43 standard deviations improvement in HAZ, compared to those who did not participate at all. This corresponds to a

6 percentage points reduction in the prevalence of stunting and a 1.7 cm increase in height on average. This is once again suggestive of complementarities in utilization. A comparison of impact between those who use both services and those who do not, suggests that this is indeed the case, with children utilizing both services being 0.34 standard deviations taller than those who only use one service. Thus, qualitatively these results are similar to those for WAZ; but are not as robust, as the HAZ impact estimates using CVM as noted above are insignificant.

As mentioned in section 4, we could not collect data for weights and heights of some children, who are likely to be healthier and, this may bias our results on impact. To test the robustness of our results, we re-estimated all our results including these children with missing data by alternatively assigning them a z-score of -1, -0.5 and 0. We find that our results are similar to those we obtained without including these children and therefore our results are not biased due to missing data (Appendix Table A.8).

## 7. Summary and Conclusions

The ICDS, which provides both supplementary nutrition and health inputs to young children, is believed to be the single-largest pre-school intervention in the world. Since its universalization in 2006, the number of ICDS centres has increased by more than 50 percent to cover more than 96 percent of villages by 2010 (HUNGaMA 2011). Yet at the same time, the expansion in utilization of all its services has not been commensurate. This provides the motivation for the first of our objectives, which is to analyse the determinants of ICDS utilization. Our second objective is to quantify the impact of ICDS utilization on child anthropometric outcomes. Though there have been several other evaluations of ICDS impact that account for attribution, most of these rely on the National Family Health Surveys, the latest of which was conducted in 2005-06. This study attempts to address the question of its impact after the expansion in coverage, although the analysis is based on a relatively small region of (11 villages in) three states in eastern India.

For the first objective, our analysis explicitly accounts for the facts that (a) the presence of an ICDS centre need not imply that all its services are available and (b) perceptions of availability of services among users may be significantly at variance from what the centres report as being available, and it is the former that matters to decisions on utilization. About 10 percent of the sample did not perceive that they were eligible for any of the ICDS services, another 20 percent of the sample believed that they were eligible to receive one (but not both) of the services. Another 30 percent did not use any service despite believing themselves to be eligible, indicating that demand factors are also important in determining utilization. Our multinomial logistic analysis of the drivers of the use of various ICDS services also confirms that it is important to account for the fact that each household in effect faces a different choice set of services available to them. This is one aspect that sets this study apart from the rest of the literature.

We find that the primary drivers of utilization are access costs, defined both in physical (distance) and social terms. Scheduled caste and scheduled tribe households are less likely to participate and when they do, are less likely to use all ICDS services. Similarly, belonging to the same caste as the ICDS worker increases the probability of participation, and in particular of using the supplementary nutrition service. This is perhaps not unexpected, as caste discrimination often translates into taboos regarding the serving of food.

To address the second objective, we use propensity score and covariate matching techniques to assess the impact of ICDS utilization on child weights and heights. In doing so, we consider the impact of ICDS services separately, and try to establish if there are complementarities in the use of both services rather than a single service. We find that in eastern Indian villages considered here, the ICDS has translated into an 11 percentage points decline in the prevalence of being underweight, a result that is robust across both matching techniques. Similarly, it has also translated into a 6 percentage points decline in the prevalence of stunting, but this result is not robust across methods. That there is stronger evidence of impact on underweight is not surprising, given the greater focus of the ICDS on supplementary nutrition. This is somewhat in contrast with the literature that shows some impact on heights, but is more ambiguous about impact on weights. There is also evidence of complementarities in impact, with children who utilize both sets of services showing greater weights (and heights) than those who utilize only one service.

Our results imply that it is important to improve awareness of entitlements, so that perceptions of lack of availability do not pose a constraint to utilization. It is also necessary to reduce access costs; which implies, first, ensuring a greater density of ICDS centres. Second, although caste-barriers are entrenched, ensuring that there a greater number of ICDS workers from scheduled caste/tribe groups and sensitization campaigns may help improve participation.

Our results on the complementarities from utilization of all services suggest that any imbalance in centres in terms of the composition of services provided be redressed; supplementary nutrition is clearly important, but so are the other vaccination, health-checkup and nutrition education components in improving child nutrition outcomes.

# Appendices

## Appendix A.1 – Defining household perceptions

We construct a measure of household perception using the household responses on reasons for not using any or a particular service. Using the responses of ICDS worker and corroborating it with household utilization (discussed in section 4.2.a), we know that both services are available at all the centres (except for investment service at one of the centre in Bihar). Thus, reason for non-utilization could not be actual non-availability, except for those villages that did not have adequate centres.

Among the households who did not participate in the program at all (95 households), 27 percent were defined to have no availability of any ICDS service based on their response for no utilization. These included not knowing about the program, not having a centre in their ward, choosing not to go to the centre because they never received any service in the past and do not believe that they will be provided any service now (implying lack of awareness about entitlement), and not being registered at the centre. The remaining non-participants in the program cited ICDS centre being too far off, services being of bad quality, child being enrolled in school and not needing ICDS services as the reason for not utilizing the service, and therefore, were defined to have access to and availability of services.

Other households, who participate in the program, may not participate in all services. We therefore, also collected information on reason for non-participation in each of the service. Again, households that report service not being made available at the centre were defined as perceiving no availability. All other households that reported not needing the service, purchasing it from some other source, poor quality of service as the reason for non-utilization, were defined to know of services being available at the centre.

Thus, the way we define household perception of availability captures both actual lack of supply (not having enough ICDS centres) and household's belief of availability.

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## Appendix Tables

Appendix Table A.1: Summary statistics for health outcomes, by type of ICDS service utilized

| Variables | Nutrition service (1) | Health service (2) | Both services (3) | None of the service (4) |
|---|---|---|---|---|
| Weight-related outcomes | | | | |
| Number of observations | 33 | 58 | 90 | 90 |
| Proportion of sample | 12.18 | 21.40 | 33.21 | 33.21 |
| Weight-for-age z-scores | -1.93 | -2.08 | -1.54 | -2.16 |
| | (0.11) | (0.33) | (0.18) | (0.16) |
| Underweight (%) | 35.24 | 52.65 | 35.71 | 59.66 |
| | (12.35) | (9.64) | (5.86) | (7.61) |
| Height-related outcomes | | | | |
| Number of observations | 30 | 48 | 81 | 82 |
| Proportion of sample | 12.45 | 19.92 | 33.61 | 34.02 |
| Height-for-age z-scores | -2.28 | -1.84 | -1.66 | -1.77 |
| | (0.29) | (0.39) | (0.25) | (0.26) |
| Stunted (%) | 45.08 | 65.46 | 48.70 | 42.28 |
| | (14.85) | (10.21) | (6.74) | (8.74) |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.
Notes: Difference between (1) and (3), and (3) and (4) are significant at 10 and 5 percent, respectively, for weight-for-age z-scores. Difference between (1) and (4), and (3) and (4) are significant at 10 and 5 percent, respectively, for underweight.
Difference between (2) and (4) is significant at 10 percent, respectively, for stunting. No other differences are statistically significant.
Standard error in parentheses.

Appendix Table A.2: Summary statistics for the sample, and by ICDS participation

| Variables | Full sample | ICDS participants | Non participants | Difference |
|---|---|---|---|---|
| Number of observations | 283 | 188 | 95 | |
| Proportion of sample (%) | 100.00 | 66.43 | 33.57 | |
| Birth order[#] | 2.56 | 2.62 | 2.46 | 0.16 |
| | (0.11) | (0.13) | (0.21) | (0.24) |
| Size at birth[##] | 2.99 | 2.96 | 3.04 | -0.08 |
| | (0.03) | (0.04) | (0.06) | (0.07) |
| Morbidity (%) | 48.30 | 52.12 | 42.94 | 9.18 |
| | (4.75) | (5.80) | (8.11) | (9.94) |
| Dietary Diversity score[###] | 11.13 | 11.54 | 10.56 | 0.98 |
| | (0.44) | (0.61) | (0.61) | (0.86) |
| Number of vaccinations received | 7.30 | 7.65 | 6.82 | 0.83* |
| | (0.22) | (0.27) | (0.39) | (0.47) |
| Household size | 7.60 | 7.68 | 7.48 | 0.20 |
| | (0.21) | (0.28) | (0.31) | (0.42) |
| Access to clean drinking water (%) | 90.70 | 85.19 | 98.44 | -13.24*** |
| | (1.95) | (3.19) | (0.99) | (3.34) |
| Using clean fuel (%) | 8.05 | 7.19 | 9.26 | -2.07 |
| | (1.55) | (1.91) | (2.64) | (3.25) |
| Defecating in open (%) | 15.02 | 14.67 | 15.52 | -0.86 |
| | (3.50) | (5.32) | (3.97) | (6.62) |
| Land less household (%) | 55.73 | 52.94 | 59.65 | -6.71 |
| | (4.41) | (5.51) | (7.10) | (8.97) |
| Marginal land holding (%) | 16.98 | 17.62 | 16.08 | 1.54 |
| | (2.59) | (3.34) | (4.10) | (5.28) |
| Medium land holding (%) | 13.06 | 15.94 | 9.01 | 6.92* |
| | (1.99) | (2.77) | (2.69) | (3.85) |
| Large land holding (%) | 14.23 | 13.50 | 15.26 | -1.76 |
| | (2.14) | (2.52) | (3.78) | (4.53) |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – 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 large and 5 implying very small, [###] – Dietary diversity score is the number of different food items consumed by child in a week preceding the survey; this was constructed using food frequency data.

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

Appendix Table A.3: Multinomial Logistic model estimates for utilization of ICDS services conditional on household perception of availability (beta coefficients)

| Variables | Nutrition service | Investment service | Both services |
|---|---|---|---|
| Distance to AWC | -0.005*** | -0.007*** | -0.007*** |
| ('00 meter) | (0.000) | (0.000) | (0.000) |
| Dummy for working | 1.401*** | 2.228*** | 1.844*** |
| Mother | (0.212) | (0.221) | (0.239) |
| Caste – SC | -3.158*** | -4.472*** | -4.605*** |
| | (0.249) | (0.244) | (0.221) |
| Caste – ST | -1.936*** | -5.753*** | -4.242*** |
| | (0.357) | (0.289) | (0.240) |
| Caste – BC | -3.163*** | -1.532*** | -1.018*** |
| | (0.218) | (0.215) | (0.191) |
| Dummy for same caste | 2.161*** | 0.004 | 0.534*** |
| as AWW | (0.158) | (0.172) | (0.153) |
| Assets owned[#] | 0.428*** | -1.174*** | -0.420*** |
| | (0.066) | (0.097) | (0.084) |
| Male Dummy | -0.707*** | -0.874*** | -0.553*** |
| | (0.107) | (0.117) | (0.107) |
| Age (in months) | -0.003 | -0.199*** | -0.046*** |
| | (0.003) | (0.006) | (0.003) |
| Birth Order[##] | 0.765*** | -0.317*** | 0.122 |
| | (0.072) | (0.086) | (0.078) |
| Mother's age (years) | -0.827*** | -0.242*** | -0.428*** |
| | (0.043) | (0.037) | (0.034) |
| Mother's education | 0.172*** | -0.146*** | -0.122*** |
| (years) | (0.022) | (0.020) | (0.018) |
| Mother's height (cm) | -0.179*** | -0.027*** | -0.035*** |
| | (0.012) | (0.012) | (0.011) |
| Father's age (years) | 0.782*** | 0.385*** | 0.570*** |
| | (0.043) | (0.037) | (0.035) |
| Father's education | -0.445*** | -0.246*** | -0.156*** |
| (years) | (0.022) | (0.018) | (0.018) |
| Number of children | 1.444*** | 1.018*** | 0.951*** |
| | (0.082) | (0.082) | (0.075) |
| Jharkhand | -1.013*** | 5.860*** | 6.497*** |
| | (0.325) | (0.243) | (0.234) |
| Orissa | -1.551*** | 1.939*** | 3.833*** |
| | (0.202) | (0.230) | (0.193) |
| Constant | 25.689*** | 10.322*** | 3.009* |
| | (1.937) | (1.754) | (1.807) |
| Log likelihood | -4696.15 | | |
| Number of observations | 249 | | |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – an index for number of assets owned constructed using PCA, [##] – Birth order 1 is assigned to first born child, and an increasing value is assigned to subsequently born children. Standard error in parentheses; ***, ** and * indicate significance at 1, 5 & 10 % respectively.

Appendix Table A.4: Different specifications of Multinomial Logistic model estimates for utilization of ICDS services using household perception of availability – Marginal effects for social access cost variable only

| Different specifications | Nutrition service | Health investment service | Both services | None of the service |
|---|---|---|---|---|
| Model 2 – includes only caste dummies and drops the dummy variable for belonging to same caste as ICDS worker | | | | |
| Caste – SC | 0.01 | -0.12*** | -0.20*** | 0.25*** |
| | (0.01) | (0.01) | (0.02) | (0.02) |
| Caste – ST | 0.10*** | -0.27*** | -0.10*** | 0.22*** |
| | (0.01) | (0.02) | (0.02) | (0.02) |
| Caste – BC | -0.13*** | -0.08*** | 0.07*** | 0.13*** |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| Model 3 – drop the caste dummies and retains the dummy variable for belonging to same caste as ICDS worker | | | | |
| Same caste as ICDS worker | 0.10*** | -0.12*** | 0.06*** | -0.03*** |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| Model 4 – includes caste dummies and the dummy variable for belonging to same caste as ICDS worker but only for SC, ST and BC caste groups | | | | |
| Caste – SC | -0.09*** | -0.09*** | -0.21*** | 0.33*** |
| | (0.02) | (0.02) | (0.02) | (0.02) |
| Caste – ST | -0.02* | -0.23*** | -0.09*** | 0.30*** |
| | (0.01) | (0.02) | (0.02) | (0.02) |
| Caste – BC | -0.22*** | -0.05*** | 0.11*** | 0.15*** |
| | (0.02) | (0.01) | (0.01) | (0.01) |
| Same caste as ICDS worker | 0.15*** | -0.03*** | -0.07*** | -0.05*** |
| | (0.01) | (0.00) | (0.01) | (0.01) |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

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

Appendix Table A.5: Results for tests conducted to evaluate matching quality between households utilizing only one of the two ICDS services (treatment) and households not participating in ICDS program (control)

| Variables | Weight-for-age z-scores | | Height-for-age z-scores | |
|---|---|---|---|---|
| | Difference in means before matching[†] | Difference in means after matching[†] | Difference in means before matching[†] | Difference in means after matching[†] |
| Distance to ICDS center (meters) | -443.25*** | -16.95 | -423.53*** | 10.11 |
| Working mother (dummy) | -0.01 | -0.00 | 0.00 | 0.01 |
| Caste-SC (dummy) | 0.04 | 0.01 | 0.05 | -0.04 |
| Caste-ST (dummy) | 0.11 | -0.06 | 0.10 | -0.01 |
| Caste-BC (dummy) | -0.01 | 0.02 | 0.05 | -0.12 |
| Same caste as ICDS worker (dummy) | 0.21 | -0.01 | 0.23*** | -0.06 |
| Asset owned[#] | -0.68*** | -0.20 | -0.73*** | -0.37 |
| Male (dummy) | 0.03 | 0.03 | 0.04 | 0.17 |
| Age of the child (months) | -17.23*** | 3.24 | -17.32*** | 3.44 |
| Birth order[##] | 0.13 | 0.01 | 0.23 | 0.16 |
| Morbidity (dummy) | 0.23*** | -0.06 | 0.25*** | -0.07 |
| Size at birth[###] | -0.01 | -0.05 | -0.03 | -0.04 |
| Mother's age (years) | -1.34 | 0.93 | -1.32 | 0.41 |
| Mother's education (years) | -0.51 | -0.72 | -1.03 | -1.06 |
| Father's age (years) | -0.70 | 1.04 | -0.86 | 0.38 |
| Father's education (years) | -1.93*** | -0.79 | -1.87** | -1.04 |
| Using clean fuel (dummy) | -0.10* | -0.05 | -0.09 | -0.09 |
| Land less household (dummy) | 0.01 | -0.14 | 0.00 | -0.01 |
| Marginal land holding (dummy) | -0.09 | -0.05 | -0.07 | 0.06 |
| Medium land holding (dummy) | 0.10 | 0.10 | 0.09 | 0.01 |
| Large land holding (dummy) | -0.02 | 0.09 | -0.02 | -0.09 |
| Bihar (dummy) | -0.33*** | 0.03 | -0.26*** | -0.03 |
| Jharkhand (dummy) | 0.27*** | -0.04 | 0.30*** | -0.02 |
| Orissa (dummy) | 0.06 | 0.01 | -0.03 | 0.00 |
| Pseudo-$R^2$ | 0.53*** | 0.17 | 0.50*** | 0.12 |
| Number of observations | 151 | | 132 | |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [†] - Difference in mean = Mean of treatment group – Mean of control group

[#] – an index for number of assets owned constructed using PCA, [##] – 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 large and 5 implying very small.

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

Appendix Table A.6: Results for tests conducted to evaluate matching quality between households utilizing both of the ICDS services (treatment) and households utilizing only one of the two ICDS services (control)

| Variables | Weight-for-age z-scores | | Height-for-age z-scores | |
|---|---|---|---|---|
| | Difference in means before matching[†] | Difference in means after matching[†] | Difference in means before matching[†] | Difference in means after matching[†] |
| Distance to ICDS center (meters) | 37.32 | -23.01 | 35.89 | -17.92 |
| Working mother (dummy) | 0.00 | 0.00 | -0.00 | -0.02 |
| Caste-SC (dummy) | -0.03 | -0.02 | -0.08 | -0.02 |
| Caste-ST (dummy) | 0.04 | 0.06 | 0.08 | 0.02 |
| Caste-BC (dummy) | -0.01 | -0.03 | -0.05 | -0.01 |
| Same caste as ICDS worker (dummy) | 0.00 | 0.05 | -0.03 | 0.07 |
| Asset owned[#] | 0.15 | -0.08 | 0.16 | 0.03 |
| Male (dummy) | -0.10 | 0.03 | -0.07 | 0.03 |
| Age of the child (months) | 23.04*** | 19.40*** | 25.93*** | 23.31*** |
| Birth order[##] | 0.33 | 0.06 | 0.16 | -0.09 |
| Morbidity (dummy) | -0.11 | 0.02 | -0.21** | 0.00 |
| Size at birth[###] | -0.11 | -0.01 | -0.11 | 0.02 |
| Mother's age (years) | 3.23*** | 0.50 | 2.88** | 0.72 |
| Mother's education (years) | -0.44 | -0.65 | -0.40 | 0.42 |
| Father's age (years) | 3.98*** | 0.52 | 3.58*** | 1.50 |
| Father's education (years) | 0.06 | 0.22 | -0.24 | 0.22 |
| Using clean fuel (dummy) | 0.01 | 0.02 | -0.05 | 0.01 |
| Land less household (dummy) | 0.05 | 0.03 | 0.07 | 0.05 |
| Marginal land holding (dummy) | 0.02 | 0.08 | -0.01 | -0.01 |
| Medium land holding (dummy) | 0.02 | 0.08 | 0.00 | 0.04 |
| Large land holding (dummy) | -0.09 | -0.19*** | -0.07 | -0.09 |
| Bihar (dummy) | -0.06 | 0.02 | -0.09 | 0.04 |
| Jharkhand (dummy) | -0.06 | -0.02 | -0.04 | -0.06 |
| Orissa (dummy) | 0.12 | -0.00 | 0.13 | 0.02 |
| Pseudo-$R^2$ | 0.42*** | 0.34*** | 0.56*** | 0.52*** |
| Number of observations | 136 | | 120 | |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [†] - Difference in mean = Mean of treatment group – Mean of control group

[#] – an index for number of assets owned constructed using PCA, [##] – 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 large and 5 implying very small.

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

Appendix Table A.7: Results for tests conducted to evaluate matching quality between households utilizing both of the ICDS services (treatment) and households not participating in ICDS program (control)

| Variables | Weight-for-age z-scores | | Height-for-age z-scores | |
|---|---|---|---|---|
| | Difference in means before matching[†] | Difference in means after matching[†] | Difference in means before matching[†] | Difference in means after matching[†] |
| Distance to ICDS center (meters) | -455.57*** | 2.63 | -433.79*** | -21.62 |
| Working mother (dummy) | -0.05 | 0.04 | -0.04 | -0.02 |
| Caste-SC (dummy) | -0.04 | 0.04 | -0.05 | -0.00 |
| Caste-ST (dummy) | 0.25*** | -0.03 | 0.26*** | 0.04 |
| Caste-BC (dummy) | -0.07 | -0.01 | -0.06 | -0.02 |
| Same caste as ICDS worker (dummy) | 0.22*** | -0.04 | 0.18** | 0.06 |
| Asset owned[#] | -0.50** | 0.03 | -0.60*** | -0.24 |
| Male (dummy) | -0.03 | -0.03 | -0.01 | 0.07 |
| Age of the child (months) | -2.40 | -4.72 | -1.41 | -1.09 |
| Birth order[##] | 0.31 | -0.16 | 0.23 | 0.02 |
| Morbidity (dummy) | 0.14* | 0.08 | 0.11 | 0.19* |
| Size at birth[###] | -0.16* | -0.01 | -0.18* | -0.04 |
| Mother's age (years) | 0.70 | -1.20 | 0.47 | -0.15 |
| Mother's education (years) | -0.41 | 1.205 | -0.84 | 0.47 |
| Father's age (years) | 2.27* | 0.83 | 1.56 | 0.24 |
| Father's education (years) | -2.19 | -0.40 | -2.60*** | 0.16 |
| Using clean fuel (dummy) | -0.10 | 0.05 | -0.14** | -0.06 |
| Land less household (dummy) | 0.03 | 0.02 | 0.05 | -0.01 |
| Marginal land holding (dummy) | -0.05 | -0.03 | -0.00 | -0.11 |
| Medium land holding (dummy) | 0.10 | -0.05 | 0.06 | 0.11 |
| Large land holding (dummy) | -0.08 | 0.06 | -0.11 | 0.01 |
| Bihar (dummy) | -0.63*** | -0.03 | -0.61*** | 0.01 |
| Jharkhand (dummy) | 0.42*** | -0.04 | 0.46*** | -0.03 |
| Orissa (dummy) | 0.22*** | 0.07 | 0.15** | 0.02 |
| Pseudo-$R^2$ | 0.62*** | 0.22 | 0.59*** | 0.20 |
| Number of observations | 149 | | 134 | |

Source: Based on data collected by VDSA and through an additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [†] - Difference in mean = Mean of treatment group – Mean of control group

[#] – an index for number of assets owned constructed using PCA, [##] – 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 large and 5 implying very small.

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

Appendix Table A.8: Re-estimating impact of ICDS participation on child weight and height by including children with missing anthropometric data, using different matching methods

| Comparisons | Impact of utilizing ICDS services on Weight-for-age z-scores | | | Impact of utilizing ICDS services on Height-for-age z-scores | | |
|---|---|---|---|---|---|---|
| | Propensity Score Matching | Covariate Matching | Number of Observations | Propensity Score Matching | Covariate Matching | Number of Observations |
| | Assuming a z-score of -1 for children with missing anthropometric data | | | | | |
| ICDS participation vs. not participating[#] | 0.48*** (0.02) | 0.65*** (0.18) | 249 | 0.11*** (0.03) | 0.15 (0.24) | 253 |
| Both services[###] vs. not participating | 0.46*** (0.03) | 0.74*** (0.17) | 153 | 0.47*** (0.04) | -0.03 (0.48) | 153 |
| Either service vs. not participating[##] | 0.18*** (0.03) | 0.34 (0.31) | 162 | 0.29***(0.04) | 0.03 (0.27) | 158 |
| Both services[###] vs. either service[##] | 0.47*** (0.05) | 0.66*** (0.23) | 138 | 0.39** (0.05) | 0.40 (0.27) | 139 |
| | Assuming a z-score of -0.5 for children with missing anthropometric data | | | | | |
| ICDS participation vs. not participating[#] | 0.49*** (0.02) | 0.67*** (0.14) | 249 | 0.17*** (0.03) | 0.08 (0.25) | 253 |
| Both services[###] vs. not participating | 0.46*** (0.03) | 0.66*** (0.17) | 153 | 0.52*** (0.04) | 0.11 (0.48) | 153 |
| Either service vs. not participating[##] | 0.17*** (0.03) | 0.36 (0.31) | 162 | 0.35*** (0.04) | 0.14 (0.27) | 158 |
| Both services[###] vs. either service[##] | 0.47*** (0.05) | 0.60*** (0.24) | 138 | 0.37*** (0.05) | 0.35 (0.27) | 139 |
| | Assuming a z-score of 0 for children with missing anthropometric data | | | | | |
| ICDS participation vs. not participating[#] | 0.50*** (0.02) | 0.69*** (0.18) | 249 | 0.22*** (0.03) | 0.02 (0.26) | 253 |
| Both services[###] vs. not participating | 0.46*** (0.03) | 0.59*** (0.17) | 153 | 0.57*** (0.04) | 0.25 (0.49) | 153 |
| Either service vs. not participating[##] | 0.17*** (0.03) | 0.39 (0.32) | 162 | 0.41*** (0.04) | 0.25 (0.27) | 158 |
| Both services[###] vs. either service[##] | 0.47*** (0.05) | 0.55** (0.24) | 138 | 0.36*** (0.05) | 0.30 (0.28) | 139 |

Source: Based on data collected by VDSA and through additional module to VDSA in Bihar, Jharkhand and Orissa in 2012.

Notes: [#] – ICDS participation implies utilizing at least one or both ICDS services, [##] – Either service implies utilizing either nutrition or investment service, [###] – Both services implies utilizing both nutrition and investment services

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