The Impact of Anganwadi Centers' Services on Infant Survival in India

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Abstract

This study explores the positive association between healthcare programs of Anganwadi Centers (AWCs) and the infant survival rate in India by using three complimentary log-log regression models. This study employed AWCs' three services—nutritional aid, immunization, and health-check—targeting pregnant/lactating mothers and children for the performance evaluation. The India Human Development Survey I, which collected the data of households including mothers who partook in Anganwadi program in her most recent childbirth between 2000 and 2005 and households including those who did not, was used in order to investigate the effectiveness of these services. The survival status of the infants as an outcome variable, a predictor variable reflecting each service, and seven control variables are included in each complementary log-log regression model. Although prior studies illustrate ineffectiveness and inefficiency of Anganwadi services, the results of this study show a statistically significant, positive association between those receiving supplementary nutrition from AWCs and infant survival rate. Further research is necessary to confirm this finding because there are several limitations in this study. Finally, this study recommended refining women's education programs and assisting self-help groups to solve India's socio-economic problems based on a discovered positive association between women's education and the infant survival rate.

Investigating the Effectiveness of Anganwadi Centers

In spite of its recent rapid economic growth, a large number of women and children in India suffer from poverty and malnutrition. Integrated Child Development Services (ICDS) is the nation-wide social welfare program of India. Its goal is to reduce high infant mortality and malnutrition rates by providing medical care to mothers and their babies alongside improving physical, psychological, and financial capacity of these mothers and local community. Anganwadi Centers (AWCs), which are the community-based, service-delivery division of the ICDS, have provided primary medical care and nutritional services to infants and their mothers in the community. Despite its significant roles and responsibilities, former studies have shown poor performance of the ICDS and AWCs. The lack of regular program evaluation resulted in ineffective and inefficient implementation of services, and some populations have limited access to AWCs. In addition, AWC social workers, known as Anganwadi workers (AWWs), have been underpaid under the government-run program. This has negatively affected workers' motivation toward public service as well as performance, and has had a negative effect on female employment in the country.

By investigating the effectiveness of AWCs, this study addresses the following question: What is the relationship between receiving Anganwadi services for pregnant/lactating women and the survival status of newborn babies in India? This study utilizes cross-sectional data and runs three complementary log-log regression models by employing predictor variables, which represent three AWC services, as well as seven control variables. The results show a positive association between AWCs' nutritional services and the survival of infants. Moreover, this study found that higher education of women in the household and general antenatal checkups are associated with low infant mortality rate in India. Given these findings, this study suggests the government may empower women by improving ICDS' adult education program and assisting community networks to enable women manage family health and the household economy.

This paper will cover topics in the following order: First, the background section outlines the brief history of the ICDS and AWCs schemes as well as their influences on the nation. Second, the literature review section presents an overview of the critical results of previous studies regarding the performance of the ICDS and AWCs. Third, the method section redefines the study question and shows three hypotheses of this study. The method section also discusses fundamental research design such as data, measures (including outcome, predictor, and control variables), and analytical strategy. The results section presents descriptive statistical results as well as the results of the three complementary log-log regression models. Lastly, the discussion section argues the limitations of this study, recommendations for future studies, and suggestions to the Indian government.

Background

Although India is listed as a BRIC state (Brazil, Russia, India, and China) which have experienced speedy and advanced economic development since the 1990s, a large number of women and children in India have historically suffered from poverty and malnutrition. Between 1986 and 2008, the Gross Domestic Product (GDP) per capita of India has almost

tripled; however, infant mortality rate of children under five per 1,000 decreased only by 50 percent over the same period. [1] [2] In 2008, the United Nations Children's Fund (UNICEF) reported that the infant mortality rate in India was 63 deaths per 1000 live births, and most deaths occur in the first month after birth.[3] According to the Central Intelligence Agency (CIA), India's infant mortality rate has decreased to 47.2 deaths per 1000 live births in 2011, yet it still ranks 52nd in the list of countries with highest infant mortality rates.[4] Additionally, underweight children are a serious problem. Malnutrition, measles, and diarrhea continue to be the major causes of child mortality, and most of the victims are children of low-income or lower-caste families.[5] The lack of clean water, sanitation, and vaccination negatively affect child health in the country.

ICDS has provided significant assistance to as the nation's health and education system for decades. The Ministry of Women and Child Development (MWCD) of India established ICDS in 1975. The roles of ICDS are providing pre-school education and primary health-care for mothers and children to break "the vicious cycle of malnutrition, morbidity, [and] reduced learning capacity and morality."[6] ICDS has served as a flagship program for India's healthcare system, and has received financial and technical support from UNICEF and the World Bank.[7] ICDS's multiple levels of service (including central, state, municipal, and village levels) and large target population make it the largest women and children's development program in the world. The ICDS target population includes poor and malnourished people at risk for malnutrition and mortality, including children below six years old, pregnant and lactating mothers, and women in the age group between fifteen and forty-five years of age.[8] After a 2008 program expansion, which established an additional 180 thousands AWCs, ICDS has run approximately 1.2 million AWCs within the nation.[9] Recent statistics show that the ICDS delivers services to 8.6 million mothers and 39.35 million children.[10] The program budget allocated by the central government has drastically increased since the 2005 reform driven by the Indian government and the World Bank. The allocations are: Rs.3,326 crore[11]

1 The World Bank, "GDP per capita (current US$)." Accessed January 27, 2012. http://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

2 The World Bank, "Mortality Rate, under-5 (per 1,000)." Accessed January 27, 2012. http://data.worldbank.org/indicator/SH.DYN.MORT?page=4.

3 UNICEF, "India: Background." Accessed January 27, 2012. http://www.unicef.org/infobycountry/india_background.html.

4 Central Intelligence Agency, "The World Factbook: Infant Mortality Rate." Accessed January 27, 2012. https://www.cia.gov/library/publications/the-world-factbook/rankorder/2091rank.html.

5 UNICEF, "India: Background." Accessed January 27, 2012. http://www.unicef.org/infobycountry/india_background.html.

6 Ministry of Women and Children Development of India, "Integrated Child Development Services." Accessed January 27, 2012. http://wcd.nic.in/icds.htm.

7 UNICEF, "The Integrated Child Development Services (ICDS)." Accessed January 27, 2012. http://www.unicef.org/india/media_2640.htm.

8 Ibid.

9 Ibid.

10 UNICEF, "The Integrated Child Development Services (ICDS)." Accessed January 27, 2012. http://www.unicef.org/india/media_2640.htm.

11 Crore, which is a numbering system used in some South Asian countries, is a unit representing ten million.

(US$ 0.67 billion)[12] in FY 2005-2006; Rs.5,665 crore (US$1.13 billion) in FY 2008-2009; and Rs.9,294 crore (US$ 1.88 billion) in FY 2011-2012.[13] The latest allocation is approximately 73 percent of the MWCD's annual budget.[14]

A unique feature of the ICDS is that most services are provided to people in need by the local AWCs at a relatively low cost. Anganwadi (meaning country-side shelter in Hindi) programs are expected to aid in the survival and development of young kids through its six areas of service: (1) supplementary nutrition; (2) immunization; (3) health check-up; (4) referral services, (5) pre-school education; and (6) nutrition and health education for adult women.[15] The largest of these is the budget allocation for supplementary nutrition.[16] AWWs are trained part-time healthcare providers, who are mostly female, and often are responsible for the care of a population of about 400-800 in the local community.[17] Their main tasks are to provide ICDS recipients with basic health education and treatment and to connect them with major hospitals or other public services if further assistance is required.[18] The MWCD licenses individual AWWs and entrusts them with the wellbeing of local clients. Since AWWs are familiar with the local languages, culture, people, and environment, they are able to closely work with their patients and find proper diagnosis.[19] The services are priced relatively low; for example, the costs of supplementary nutrition are Rs.2.00 (US$0.04) and Rs.2.30 (US$0.05) for children and pregnant/nursing mothers respectively.[20] These prices are less than half of what the government charged before the 2008 program reform.[21]

Literature Review

Though the budget and physical capacity of ICDS have increased over the years, previous studies present ICDS's low-level effectiveness on early childhood development. Gragnolati *et al.* (2006) researched the association between India's infant malnutrition rate and ICDS performance, and found that beneficiaries tend to utilize only immunization and nutritional services while local AWCs provide a broader range of six services. As a result, it prevents maximizing positive outcome of ICDS.[22] Lokshin *et al.* (2005) indicates that the AWC services are more likely to reach children three to six years of age than newborns, though older children are often less vulnerable than younger children to malnutrition, bad domestic

12 These reflect currency exchange rate of January 27, 2012.

13 Kapur, Avani, and Anirvan Chowdhury. "Integrated Child Development Services, GOI 2011-2012." *Budget Briefs-Integrated Child Development Services*. 3. no. 3 (2011), 2.

14 Ibid, 2.

15 Ministry of Women and Children Development of India, "Integrated Child Development Services." Accessed January 27, 2012. http://wcd.nic.in/icds.htm.

16 Ibid.

17 Ibid.

18 Ibid.

19 Ibid.

20 Ibid.

21 Ibid.

22 Gragnolati et al., "ICDS and Persistent Undernutrition: Strategies to Enhance the Impact." *Economic and Political Weekly.* (2006): 1197.

environment, or poor family health management.[23] Another study conducted by Kandpal (2011) supports the significant effects of ICDS, especially for poor children suffering from malnutrition, but he concludes that ICDS failed to distribute resources to communities in which average education is low and sex ratio is unbalanced.[24]

Das Gupla *et al.* (2005) insist that the existing ICDS scheme has both implementation and design problems. The three major implementation problems are (1) a lack of valid training and management of AWWs, (2) its undeveloped resource supply mechanism, and (3) poor targeting strategy of the food supplementation service.[25] In terms of the program design failure, Das Gupla *et al.* (2005) emphasize the weakness of ICDS's top-down decision-making process. Since a gap between the demands of beneficiaries and the program function easily occurs, AWCs and AWWs are not enough to hold the program accountable.[26] This also negatively affects the AWWs' work motivation and performance. Lastly, Das Gupla *et al.* (2005) report that the MWCD opts to put more efforts on old-fashioned approaches such as nutritional supplementation than the more cost-effective approaches including adult education and family-based health promotion.[27] The fact that the current budget allocation to nutritional supplementation is the largest among the six services corroborates this finding. Former studies note that the government has injected funds to the ICDS regardless of its effectiveness and efficiency.

The recent protests of AWWs underline the ICDS's problem with human resource management. A large number of AWCs have demanded a salary increase for the workers and more resources from the central government. The government has not distributed the funds yet due to its current budget constraints although it once acknowledged the request.[28] Compensation for AWWs is a controversial issue because historically AWWs are recognized as "volunteers who are paid an honorarium" by the MWCD.[29] Palriwala and Neetha (2010) report that the salary of AWWs are lower than the minimum wage of India, and widows, divorced women, and women in the scheduled (lower) caste are less likely than others to be licensed by the MWCD (lower)s due to their weaker social status.[30] This unequal employment inequality decreases overall number of AWWs in the nation. Due to the lower payment to AWWs, women with higher education and advanced skills prefer working in the other sec-

23 Lokshin et al. "Improving Child Nutrition? The Integrated Child Development Services in India." *Development and Change*. 36. no. 4 (2005): 623.

24 Kandpal, Eeshan. "Beyond Average Treatment Effects: Distribution of Child Nutrition Outcomes and Program Placement in India's ICDS." *World Development*. 39. no. 8 (2011): 1410.

25 Das Gupta et al. *Improving Child Nutrition Outcomes in India: Can the Integrated Child Development Services Be More Effective?*. (Washington, DC: The World Bank, 2005), 4.

26 Ibid, 4-5.

27 Ibid, 4-5.

28 ----. "Anganwadi Workers Protest for Higher Wages." The Hindu, October 4, 2011. Accessed January 27, 2012. http://www.thehindu.com/todays-paper/tp-national/tp-karnataka/article2510912.ece?css=print

29 Palriwala, Rajini, and N Neetha. "Care Arrangements and Bargains: Anganwadi and Paid Domestic Workers in India." *International Labor Review*. 149. no. 4 (2010): 514.

30 Palriwala, Rajini, and N Neetha. "Care Arrangements and Bargains: Anganwadi and Paid Domestic Workers in India." *International Labor Review*. 149. no. 4 (2010): 513-514.

tors. This results in an inefficient program implementation as well as a secondary status for women in the Indian job market.[31]

In the context of these prior studies, this study attempts to answer the following questions: are the Anganwadi services really effective on solving India's high mortality rate? If so, which service has been most effective? Many previous evaluations of the ICDS performance focus on its effectiveness on child malnutrition; hence, this study takes a different approach and reevaluates the program based on the change in the infant mortality rate.

Method

Hypotheses

Given the three hypotheses, this study investigates the effects of AWCs on the infant mortality rate in India. This study employs three Anganwadi services out of the six—supplementary nutrition, immunization, and health check-up— to look at the program effectiveness because the three have stronger impacts than others on infant mortality rates due to their target population (i.e. pregnant/lactating mother and children below six years). The hypotheses in detail are below.

H1: AWCs' nutritional aid is associated with reduction of infant mortality rate in India.

H2: AWCs' immunization service is associated with reduction of infant mortality rate in India.

H3: AWCs' health check-up is associated with reduction of infant mortality rate in India.

Data

This study uses cross-sectional data named India Human Development Survey I (IHDSI), which contains extensive data on households located all over India. A joint team consisting of the University of Maryland (UM), the National Council of Applied Economic Research (NCAER), and New Delhi collected the data by conducting interviews at 41,654 households in India between October 2004 and October 2005.[32] UM used random sampling and collected data from thirty-three India states and union territories out of thirty-five.[33] This implies that IHDSI is nationally representative.[34] The IHDSI was chosen for this study because it contains data on the last babies born between 2000 and 2005 at each household, the survival status of these infants, and whether or not mothers received services provided by the local AWC in their last childbirth between 2000 and 2005. These variables are useful to determine the ICDS and AWCs effectiveness to reduce the infant mortality rate.

31 Ibid.

32 University of Maryland, "India Human Development Survey." Last modified February 15, 2011. Accessed January 27, 2012. http://ihds.umd.edu/.

33 Ibid.

34 Two union territories that are not included in IHDSI are Andaman and Nicobar Islands and Lakshadweep. There was no change in the number of India's states and territories between 2005 and 2012 while some states changed their official names.

Measures

Outcome

The survival status of the most recently born infant is the outcome variable. IHDSI's survey question categorized the health status of infants as dead, alive, inconsistent, don't know, and valid blank[35]. Because the objectives of this study is to create a comparison group and determine the effectiveness of the services delivered by AWCs, inconsistent, don't know, and valid blank were removed. Valid responses were coded "0" for the households which experienced death of infants in the most recent childbirth between 2000 and 2005 and "1" for the households with a living infant who was born in his/her mother's last childbirth in the same time period.

Predictor

The predictor variables for the three models represent whether or not mothers received services from AWCs. IHDSI uses eight categories which include: No; Yes while pregnant; Yes while lactating; Yes while pregnant & lactating; inconsistent; valid skip; and valid blank. This study removed inconsistent, valid skip, and valid blank, and grouped all three Yes answers into one. Valid responses were coded as "1" for Yes and "0" for No. The study coded all households with mothers who involved in at least one of these Anganwadi programs as "1". The frequency of services was not considered in this study.

Controls

This study used seven control variables including the urbanization level of the place where each house was located, caste category of the family, the highest education among female family members, the number of years living in the current residence, toilet and water-resource status of each household, and whether the mother received a antenatal check-up for her last childbirth. Invalid or inconsistent answers in IHDSI were removed from the sample. IHDSI defined urbanization level based on the census data of 2001 and coded as "1" for urban areas and "0" for rural areas.[36] The urbanization level is important as control variable for two reasons: First, the majority of AWCs (94 percent) located in rural areas in 2003 so that people had an unequal access to the service delivery bodies.[37] Second, people in the scheduled caste mostly reside in rural areas, and about 50 percent of population in the scheduled caste and tribe was below the poverty line in the early 2000s.[38] Urbanization level often reflects poverty level and social status of Indian population.

35The definition of "valid blank" is not clearly explained by the IHDSI codebook, however, it is categorized as a type of missing data.

36 Desai, Sonalde, and Reeve Vanneman. *India Human Development Survey (IHDS), 2005: Household Codebook*. Ann Arbor, Michigan: Inter-University Consortium for Political and Social Research, 2005.

37 Das Gupta et al. *Improving Child Nutrition Outcomes in India: Can the Integrated Child Development Services Be More Effective?*. (Washington, DC: The World Bank, 2005), 4.

38 Mohanty, B.B. "Land Distribution among Scheduled Castes and Tribes." *Economic and Political Weekly*. 36. no. 40 (2001): 3857.

Caste category of each family was coded as "1" for people inside the Hindu caste (Brahmin and higher castes) and "0" for people in the depressed castes (scheduled caste and other backward castes). Caste status is significant because, as Von de Poel and Speybroeck (2009) point out, the lower socioeconomic status of people in depressed class tends to be associated with the higher malnutrition rates and lower use of healthcare.[39]

The highest education among female members in each household was categorized as "1" for tenth grade or higher completed and "0" for lower than tenth grade completed. The IHDSI does not have separate variables representing education of mothers of newborn babies, however, this study assumed that more educated female members made the other women in the same household more sensitive about and/or interested in prenatal care. In addition, female education can be considered as an income measure of each household.

The category for years in the current residence determines whether mothers received services from the AWCs located near the old or current residence. It was coded as "1" for households staying at current location for at least five years and "0" for less than five years. Because the IHDSI counted survival status of children born between 2000 and the day when the survey was conducted (2004 or 2005), mothers living in a current residence for less than five years might not be familiar with local AWWs and/or AWCs.

Although IHDSI has data on total revenues and expenditures of households, this study employed water and toilet conditions as income measures. Desai and Wu (2010) argue that running water and indoor toilets more accurately reflect a household economic status beneficial for maternity care than its level of income.[40] The water source was coded "1" for running and bottled water and "0" for non-running water (i.e. well, river, pond). The toilet type was coded "1" for developed toilet (i.e. flush toilet) and "0" for undeveloped ones (i.e. traditional latrine, v.i.p. latrine, and open filed). This study assumes that mothers with a better house environment could maximize the benefits from AWCs and AWWs.

IHDSI asked the question: "When you are pregnant with ([child] name), did you have an antenatal checkup [?]."[41] The answers do not specify whether mothers had received antenatal checkup(s) from AWCs, hospitals, or other medical clinics. Nonetheless, this study used this output as a control variable for extra antenatal checkups which seem to curve the infant mortality rate. Antenatal checkups were coded as whether the mothers had received checkup or not (1=Yes, 0=No).

Analytical Strategy

The analytical method used in this study is a complementary log-log regression. Powers and Xie (2000) mention that complimentary log-log model is an alternative to logistic regres-

39 Van de Poel, Ellen, and First Speybroeck. "Decomposing malnutrition inequalities between Scheduled Castes and Tribes and the remaining Indian population."*Ethnicity & Health*. 14. no. 3 (2009): 272.

40 Desai, Sonalde, and Lijuan Wu. "Structured Inequalities—Factors Associated with Spatial Disparities in Maternity Care in India." *The Journal of Applied Economic Research*. 4. no. 3 (2010): 303.

41 Desai, Sonalde, and Reeve Vanneman. *India Human Development Survey (IHDS), 2005: Household Codebook*. Ann Arbor, Michigan: Inter-University Consortium for Political and Social Research, 2005. 518.

sion and is especially useful when the outcome is skewed to one side of a binary outcome.[42] The complimentary log-log regression is appropriate for this study because, as Table 1 shows, child mortality is a very rare occurrence; only 1.27% of households experienced the death of infant who was born between 2000 and 2005. This study used a significance level of 0.05.

Results

Descriptive Statistics Result

This study used a non-experimental sample; the total number was 9,711. The unit of analysis is the household. In the sample, 1.27% (123) of the households experienced the death of an infant born in the mother's last birth between 2000 and 2005, and 98.73% (9,588) of the households had a living infant born in the same time frame. For the AWCs' supplementary nutrition, the mothers in 18.37% of the households (1,784) received the service. Similarly, 22.89% (2,223) and 17.53% (1,702) households were recipients of the immunization and health-check services, respectively. The majority of the households lived in rural areas (66.18%: 6,427) and were depressed caste 80.79% (7,846). Almost one-fifth of the households (2,245) had women who were at least 21 years old and had passed tenth grade or higher. Only 4.98% (484) of the households had changed their residence in the past four years. In terms of income measures, the water source of about 60 percent households (6,255) were well, river and/or pond, and most households (77.25%: 7,502) utilized traditional style of toilets such as traditional latrine, ventilated improved pit latrine, and open-field toilet. These results show that the majority of the sample resided in rural area and were relatively poor. Finally, mothers in about 80 percent of households received some type of antenatal checkup while they were pregnant and/or lactating in the last time. Table 1 summarizes all of descriptive statistics.

42 Powers, Daniel A., and Yu Xie. *Statistical Methods for Categorical Data Analysis*. San Diego, CA: Academic Press, 2000. 84.

Table 1: Descriptive Statistics (N=9,711)

Variable (Type)	Description of Variable	Coded as 0	Coded as 1
SURVIVAL (Outcome)	Survival status of infants in the last childbirth at each household (between 2000 and 2005)	Dead (1.27%: 123)	Alive (98.73%: 9,588)
NUTRITION (Predictor for Model I)	Whether a mother in household received nutrition supplementation from Anganwadis in her last childbirth	No (81.63%: 7,927)	Yes (18.37%: 1,784)
IMMUN (Predictor for Model II)	Whether a mother in household received immunization service from Anganwadis in her last childbirth	No (77.11%: 7,488)	Yes (22.89%: 2,223)
HEALTH (Predictor for Model III)	Whether a mother in household received health-check service from Anganwadis in her last childbirth	No (82.47%: 8,009)	Yes (17.53%: 1,702)
URBAN (Control)	Urbanization level of where the households located	Rural (66.18%: 6,427)	Urban (33.82%: 3,284)
CASTE (Control)	Caste category of each household with mothers	Depressed Class (80.79%: 7,846)	Higher Caste (19.21%: 1,865)
FEMALE_ED (Control)	Highest education among female family in each household	No-9th Grades (76.88%: 7,446)	10th Grade+ (23.12%: 2,245)
RESIDENCE (Control)	Number of years living in the current residence	< 5 years (4.98%: 484)	>= 5 years (95.02%: 9,227)
WATER (Control)	Type of water resource used in each household	Non-running (58.44%: 6,255)	Running/Bottled (41.56%: 4,448)
TOILET (Control)	Toilet type employed in each household	Traditional Toilet (77.25%: 7,502)	Flush Toilet (22.75%: 2,209)
EXTRA_CARE (Control)	Whether a mother in households received any types of antenatal-check in her last childbirth	No (20.55%: 1,996)	Yes (79,45%: 7,715)

Complimentary Log-Log Regression Results

Model I: The Influence of Anganwadi Supplementary Nutrition Services on Infant Mortality Rate

The results of the first complimentary log-log regression model, which is an approach for the first hypothesis, present a statistically significant association between receiving nutritional aid from AWCs and infant survival rate. Table 2 summarizes the results. The first complimentary log-log model shows that receiving supplementary nutrition from AWCs is associated with 0.2 unit increase in the child's survival rate, holding constant all other independent variables in the model. This is statistically significant because the p-value is 0.003 (<0.05). This model also confirms statistically significant positive associations of women's education and antenatal checkup with the infant survival rate. In this model and the following two, the highest correlation between variables is 0.42 between urbanization level and water-resource status of each household; therefore, the models used in this study do not have a serious risk of multicollinearity.

Model II: The Influence of Anganwadi Immunization Services on Infant Mortality Rate

A statistically significant relationship between the immunization services of AWCs and the infant survival rate at the employed p-level was not observed in the results of the second model. The output shows that the coefficient of the immunization service is 0.11, which implies a positive association between the service and the infant survival rate; however, this is not statistically significant because the p-value is not less than 0.05 (0.053). See Table 2 for the detailed results.

Model III: The Influence of Anganwadi Health-Check Services on Infant Mortality Rate

This study was also not able to support a positive relationship between the Anganwadi health-check services and the infant survival rate at the employed p-level. As Table 2 presents, the coefficient of 0.13 implies that the health-check services is associated with 0.13 unit increase in the infant survival rate in India, but the p-value is greater than 0.05 (0.051).

Table 2: Results of the Three Regression Models

Variable	**Model I** Coefficient (SE)	**Model II** Coefficient (SE)	**Model III** Coefficient (SE)
NUTRITION (0=No, 1=Yes)	0.20 (0.07)*	-	-
IMMUN (0=No, 1=Yes)	-	0.11 (0.05)	-
HEALTH (0=No, 1=Yes)	-	-	0.13 (0.06)
URBAN (0=Rural, 1=Urban)	0.0005 (0.05)	-0.01 (0.05)	-0.01 (0.05)
CASTE (0=Depressed, 1=High)	0.04 (0.06)	0.04 (0.06)	0.03 (0.06)
FEMALE_ED (0=10th>, 1= 10th=<)	0.14 (0.06)*	0.14 (0.06)*	0.15 (0.06)*
RESIDENCE (0=5yrs>, 1=5yrs=<)	-0.05 (0.11)	-0.05 (0.11)	-0.05 (0.11)
WATER (0=Non-running, 1=Running/bottled))	0.01 (0.05)	0.01 (0.05)	0.01 (0.05)
TOILET (0=Traditional, 1=Flush)	-0.004 (0.06)	-0.01 (0.06)	-0.07 (0.06)
EXTRA_CARE (0=No, 1=Yes)	0.19 (0.05)***	0.19 (0.05)***	0.19 (0.04)***
CONSTANT	1.33 (0.12)***	1.33 (0.12)***	1.35 (0.12)***
N	9,711	9,711	9,711

*=p<0.05, **=p<0.01, ***=p<0.001

Discussion

Given research design, this study only confirms that the nutritional service from AWCs is a significant determinant of infant survival in India; however, it is important to understand limitations which might make this research fail to capture real effects of the immunization and health-check services. The results of Model I is consistent with the fact that malnutrition, which often causes growth failure in infants, is the major health problem in India. In other words, malnutrition is a more significant determinant of infant survival than general health services in the state. There are two limitations in this study to evaluate the influence of the immunization services. First, IHDSI only counted the beneficiary status of mothers, but not their children's, in terms of the immunization services. Therefore, the mother's immunity against a certain disease less likely influenced a child's survival. Similarly, IHDSI does not specify what kind of immunization the mothers took. The mothers might be immunized against different diseases such as influenza, typhoid, and measles. If this is correct, the Anganwadi immunization services differently affected the mother's health as well as their children's.

There are other limitations to this study such as sampling error, specification error, functional form error, and relatively old data. First of all, missing data is the major risk of this study. The joint team of UM, NCAER, and New Deli might select sample to which they have easier access than others. Or, some of the interviewees or interviewers might be biased to certain questions. This would affect the data's generalizability. Sampling errors generally cause external invalidity of a study. Additionally, this study removed all invalid responses (i.e. inconsistent, valid skip, and valid blank) from the sample.

Also, there is the risk of specification error due to omitted variables. For instance, if data allows, the future study could include data on age and education of mothers, age of infants, frequency of service delivery, and experience and skills of each AWW. Mothers who were relatively young and highly educated might be able to minimize the risk of malnutrition and growth failure in their children. Also, as noted earlier, children's age has a strong impact on their survival. Frequent service delivery and skilled workers would also positively affect health of mothers and children. This study has a problem of reliability due to these omitted variables.

Furthermore, the measures used in this study may not be relevant. With regard to outcome variables, this study selected a very simple outcome: survival status of infants (alive or dead). There are many scales which can be employed to measure infant malnutrition such as child birth weight and annual growth rate. In addition, because the IHDSI counted all infants regardless of the birth year within the range of 2000 and 2005, the economic condition and/or development level of society might differently affect the infant mortality rate on a yearly basis. Moreover, the level of urbanization, which is based on 2001 census data, might not correctly represent the urbanization level of the area where each household was located. Also, the type of water resources and toilets may not be the best income measure because each household has different consumption preferences.

Lastly, because IHDSI is relatively old data, the findings of this study may not be helpful for current Anganwadi protesters to show their effectiveness and accomplishments to the government in order to demand an increase in their salary and budget. Further studies with more recent data would more accurately portray performance and needs of Anganwadis and could encourage the government to expand the capacity of the services.

An unexpected finding of this study is the positive associations of higher education among women and general antenatal checkup with children's survival. As Table 2 shows, women's education and general health-check are associated with about 0.15 and 0.20 unit increase in the children's survival rate. This finding corroborates the principles of ICDS, although the ICDS's adult education program for women in the age group of fifteen to forty-five only teaches them basic tips to appropriately take care of their family's health, nutrition, and development. This type of education is not usually considered formal education (and unfortunately IHDSI did not include data on the ICDS adult education program); however, the Indian government would be able to improve its infant survival rate by further developing the adult education program under the ICDS framework. Furthermore, the government could benefit from encouraging educated females to assist self-help programs and activities. Self-help group, which usually consists of ten to twenty members living near one another, is an effective method to decrease the poverty rate in India. Grass-root networks have promoted mutual health and financial literacy among the members.[43] It is worth for the government to consider providing more resources to these groups in order to strength ties among women residing in the same community.

In sum, this study corroborates the effectiveness of AWC's nutritional services on infant survival in India despite several limitations. The two policy recommendations which this study addresses are (1) refining ICDS's adult education program and (2) financially and technically assisting self-help groups of women in preventing malnutrition and enhancing health education and economic capacity of local communities. Future research could more accurately present the impacts of Anganwadi programs on India's infant survival rate if it uses more recent data and a more sensitive research design, ideally with experimental time-series data. More accurate impact assessments of ICDS and AWCs are required not only to reduce the infant mortality rate but also to solve more complicated socio-economic problems in India such as income, education, and gender inequality.

43 CS Reddy, and Sandeep Manak, *Self-help groups: A keystone of microfinance in India- women empowerment and social security*, Hyderabad, India: Mahila Abhivruddhi Society, Andhra Pradesh, 2005. 3.

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