Impact of Female Literacy and Workforce Participation on Child Nutritional Status in India: Panel Data Estimation

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OIDA International Journal of Sustainable Development, Ontario International Development Agency, Canada
ISSN 1923-6654 (print) ISSN 1923-6662 (online) www.oidaijsd.com
Also available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Abstract: The current study aims to analyze the impact of maternal education and work status on child nutritional status in India. Child nutrition status is measured by underweight (Low weight-for-age), stunting (low height-for-age) and wasting (low weight-for-height). The study is based on the three rounds of NFHS data from 1992-93, 1998-99 and 2005-06 survey. The results suggest a significant impact of both maternal work status and education on the three indicators of nutrition standards. The results suggest that an increase in the percentage of non-working mothers leads to a negative impact on a child's physical development in terms of height, weight and overall growth. Female's literacy rates are not only seen to be associated significantly in reduction of the percentage of children being underweight, stunted or wasted, but also contributes in bringing down the child mortality rate in India.

Keywords: Hausman test, Malnutrition, Panel Data, Stunting, Underweight, Women work force

Introduction

Nutrition is the keystone that affects and defines the health of all people and paves the wayto grow, develop, work, play and resist infection. A good nutritional start impacts an individual's physical, mental and social development for life. Adequate nutrition is essential in early childhood to ensure healthy growth, proper organ formation and function, a strong immune system, and neurological and cognitive development. Economic growth and human development require well-nourished populations to learn new skills, think critically and contribute to the communities.Children representthe future of the society and hence their nutritional status is of immense importance in any country. Malnutrition in children is common globally but it is more prevalent in developing countries including India. Child malnutrition results in both short and long-term irreversible negative health outcomes including stunted growth which may also be linked to cognitive development deficits, underweight and wasting. The World Health Organizationestimates that malnutrition accounts for 54 percent of child mortality worldwide,about 1 million children(Walker, Duggan, & Watkins, 2003). Another estimate by World Health Organisation(2008) states that childhood underweight is the cause for about 35% of all deaths of children under the age of five years worldwide.

This paper seeks to examine the impact of mother's literacy and work status on child's health. The study explores the relationship between mother's literacy, workforce participation and child's nutrition for 28 states of India using data from three rounds of NFHS (1992-93, 1998-99 and 2005-06)[1]. The study also includes other control variables that could significantly impactchild's nutritional status such as state per capita income, child immunization, sanitation facilities and urbanization.

Nutritional status of children is generally measured by three indices, i.e. weight-for-age, height-for-age and weight-for-height. Low weight-for-age is known as underweight, low height-for-age is known as stunting and low weight-for-height is known as wasting.Each of these indices providesdifferent information about the nutritional status of children. Wasting is acute malnutrition which results due to acute inadequate nutrition leading to rapid weight loss or failure to gain weight normally. Stunting or shortness is chronic malnutrition that results due to inadequate nutrition over a long period of time leading to failure of linear growth. Underweight can be either acute or chronic. It

[1] NFHS is National Family Health Survey is a large scale, multi round survey conducted for a representative sample of households throughout India. So far, the survey has been conducted in 3 rounds.

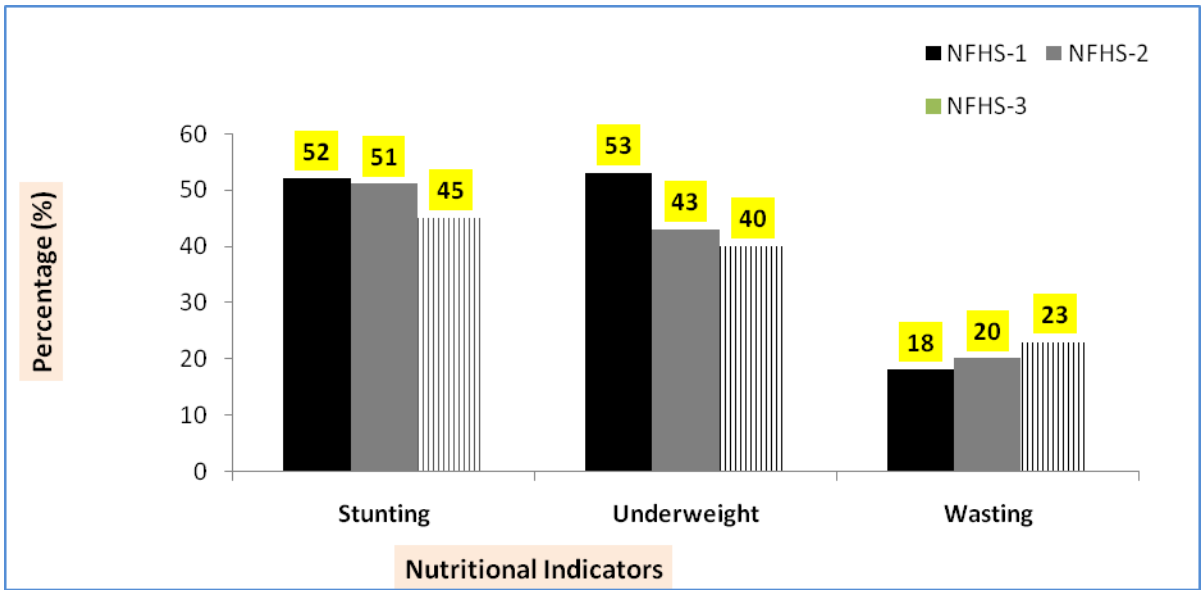

Figure 1. Trends of Undernutrition in India

is a combination measure and it could occur as a result of wasting, stunting or both. The three nutritional status indices are expressed in standard deviation units (z-scores) from the median for the international reference population. Children who fall more than two standard deviations below the reference median are considered to be undernourished.

The three survey waves of NFHS were used to assess the trend of undernutrition (stunting, underweight, wasting) prevalence over the years.The trend is represented in Figure 1 above. The prevalence of childundernutrition significantly varied in the three survey waves.

There was a notable decline in the prevalence of stunting and underweight between NFHS 1 (1992-1993) and NFHS 3 (2005-2006).While 45.0% of the children were stunted in NFHS 3, it was as high as 52.0% in NFHS 1. A 24.5% decline in underweight was also observed across the three survey waves. However, the prevalence of wasting has become worse over time increasing from 18% in NFHS 1to 20% in NFHS 2 and then 23% in NFHS 3.

Under five children are mostly dependent on mother for all their nutritional needs. Hence mother being themajor care provider for the child, her educational and work status may have an important bearing on the nutritional status of the child.The relationship between mother's workforce participation and child health is complex.On one hand, labor force participation can have an adverse impact on childhealth with mother's lesser time and attention. On the other hand,mother'sworkforce participationenhances the family income which in turn has a positive impact on child health. Similarly, the way in which maternal education influences child health and mortality is complex and has different facets. The fertility behavior of educated mothers minimizes child mortality risk. Maternal education can promote better child care practices at home and more intensive use of preventive and curative health care. Education also provides greater independence to women which can help them to take child health-promoting decisions without any hindrance**.**It is also believed that the effectiveness with which basic child-health-promoting inputs, such as personal hygiene, prenatal and postnatal care, and feeding practices are combined, improves with the level of education of the mother.Therefore, educated girls are more likely to raise healthy, well-nourished, educated children. The effect of mother's education on the nutritional status of children has been examined in NFHS-3. Data indicates that Children whose mothers have little or no education tend to have a lower nutritional status than the children of better-educated mothers. 57.2 percent of children were stunted whose mothers had no education as compared to 21.9 percent children whose mothers had 12 or more years of education. Similarly, percentage of underweight children fell from 52 to 17.9 as education of mothers increased from 'no education' to '12 or more years'. This finding suggests that women's education and literacy programmes could play an important role in improving children's nutritional status.It is clear and evident from figure 2 that there is a reduction in all the three measures of child malnutrition, i.e. stunting, wasting and underweight as mother's education increases in years. Stunting and underweight show a greater fall with an increase in maternal education as compared to wasting.

Sanitation is another important factor that can influence child health significantly. Sanitation and hygiene are key to child survival, development,and growth of children. Unsafe water, poor sanitation,and hygiene are directly linked to under nutrition in children as it can causediarrhoea, intestinal worms and environmental enteric dysfunction (EED). The World Health Organization (WHO) estimates that 50% of under nutrition is associated with infections caused by unsafe water, inadequate sanitation or insufficient hygiene.The link between malnutrition and poor sanitation is even stronger when population density is high. Therefore, India's widespread open defecation and high population density place children at an increased threat of malnutrition. This also helps in explaining the "Asian enigma", whereby despite increases in economic growth, children in Asia are shorter on average than are those in Africa, who are poorer (Spears & Ghosh, 2013)**.**
Figure 3showsunder nutrition among children by sanitation facility (type of toilet facility) at households for third round of NFHS. Use of improved facilities reduces the risk of contracting diarrhoeal diseases. In India, more than half of households (55 percent) do not have any toilet facility and household members practice open defecation(NFHS-3, 2005-06)

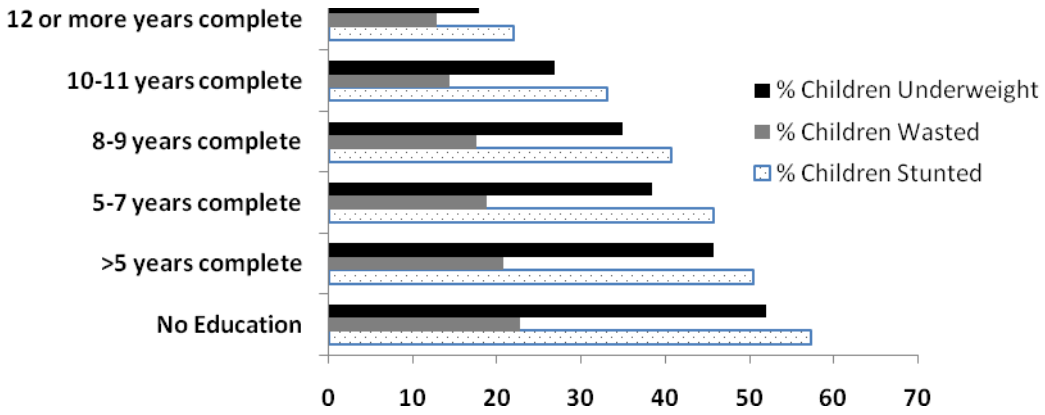

Figure 2. Malnutrition level of children under five years of age by sanitation facility 2005-06

We can see in the figure that-

- Young children in households that use improved toilet facilities are much less likely than other children to be stunted, wasted, and underweight.
- Almost half of children in households without improved toilet facilities are underweight, compared with only 28 percent of children in households with improved toilet facilities. More than half of children in households without improved toilet facilities are stunted compared with 34 percent in households with improved toilet facilities.

Immunisation is an integral part of a primary healthcare platform reaching children multiple times in their first years of life. Vaccines prevent disease in children who receive them and protect those who come into contact with unvaccinated individuals. Vaccines are responsible for the control of many infectious diseases including polio, measles, diphtheria, tetanus, and Haemophilus influenza. There are also evidences to show that vaccines can help prevent some of the chronic consequences of under-nourishment. A study by(Anekwe & Kumar, 2012)suggests that the children in India with up-to-date vaccines against tuberculosis, diphtheria, tetanus, pertussis, measles and polio were less likely to show signs of stunting.

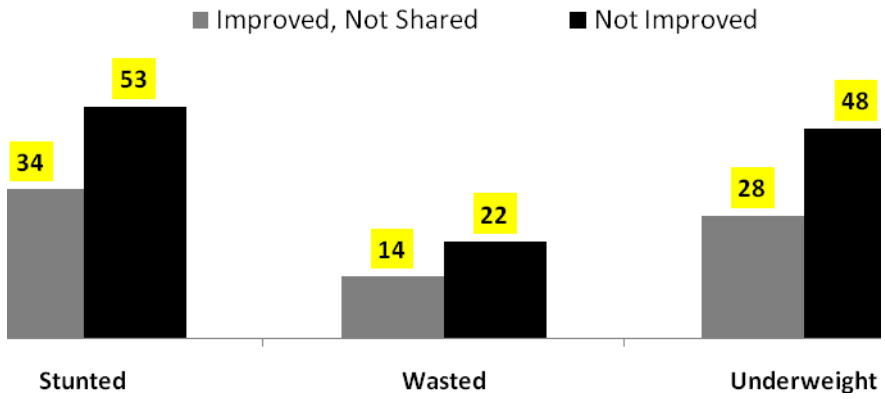

Figure 3. Malnutrition level of children under five years of age by sanitation facility 2005-06

Literature Review

Literature on India so far has barely specifically investigated the effect of mother's work status and literacy on child health. Studies associating maternal work with child nutrition bear conflictingoutcomes. While some have shown significant negative influence of maternal work on child nutrition (Engle & Pedersen, 1989), others have shown a positive impact (Leslie & Paolisso, 1988).Most of the empirical research associating mother's education and child healthreported a positive association between these two. Maternal education is a crucial determinant of child health and there are many studies which have showed a direct impact of maternal education on child's health.
In a studyM.Sivakami(1997)examined the linkage between mother's work and child health based on a survey of 75 working and 75 nonworking currently married women below 45 in a village in Tamil Nadu.The study showed that the children of working women are more prone to illness even when socio-economic variables are controlled but at the same time study also says that this need not necessarily imply that a woman's preference for work goes against the interest of her children. A working woman raises the household income which makes it possible to provide better food and health care to children. The coverage of child immunization was fairly high for both groups (working and nonworking women) and education of mother hada positive significant effect on child's nutritional status as expected.

Another study Bamji(1998)investigatedthe complex relationship between rural mothers' work pattern and maternal and child nutrition status. Nutrition status of the mothers and the pre-school children was assessed by measurement of height and weight together with haemoglobin levels and riboflavin status. Main finding of the study was that neither the mothers'occupation nor land holding influenced children's nutrition status. Also, no influence of mother's occupation was observed on haemoglobin and riboflavin status of children.

In his paper, Tulasidhar(1993)studied the impact of maternal education andlabour force participation on child mortality. The paper focused mainly on how the strength ofthe inverse relationship between child mortality rates and mother's education varies with the duration of education in different states of India and it also examined the impact on child mortality of female labour force participation at different levels of education.The study found that the child mortality among illiterate mothers was fairly high even in low mortality states and rates of child mortality vary widely between states.Both the length of mother's education and the female labour force participation rate showed a statistically significant inverse relationship with child mortality.The estimates of coefficients, which indicate the relative influence of education and the female labour force participation on mortality rates, suggestedthat the impact of education was approximately three times stronger than that of the female labour force participation rate.
An articleby Basu & Basu(1991)focused on negative aspect of female employment i.e., its impact on the physical welfare of the child, measured by the level of childhood mortality. The hypothesis was that a major explanation for the higher child mortality experience of working women can be found in their greater physical inability to look after their children themselves and to arrange adequate substitutechildcare.The study has differentiated between direct and indirect impact of mother's work status on child mortality. The indirect effect has been described in the form of

increased household's income.The results suggested that at similar household income levels, working women experience higher child loss than non-working women. Therefore, the study examined various intermediate mechanisms and concluded that shortage of time is one of the major reasons for this negative relation between maternal employment and child survival.

Growing evidence suggests a link between child linear growth and household water, sanitation and hygiene (WASH) practices.India demonstrated a strong association between the prevalence of open defecation and stunting, after adjusting for potential confounders. There is a studyby Rah et.al.(2015)that sought to determine the association between stunting and household access to sanitation facilities, water supply and personal hygiene practices using three large data sets obtained from the 2005–2006 NFHS-3, the 2011 Hunger and Malnutrition survey and the 2012 Comprehensive Nutrition Survey in Maharashtra (CNSM). Multiple logistic regression analyses were used to examine the association between the risk of stunting and WASH practices adjusting for potential confounders.In multivariate analysis, household access to toilet facility was associated with a 16–39% reduced odds of stunting among children aged 0–23 months. On the other hand, household access to an improved source of drinking water or piped water, in particular, was not a predictor of stunting. The findings of this analysis, based on three large survey data setsreinforce the notion that poor sanitation may indeed greatly increase the likelihood of child stunting in rural India where open defecation is pervasive and the burden of child stunting is massive.In conclusion, this analysis revealed that household sanitation and the mother's reported personal hygiene practices are strong predictors of child stunting in India.

A previous study on income growth and child malnutritionby Haddad, Alderman, Appleton, Song, & Yohannes(2003)studied the linkage between child malnutrition and income growth using household survey data from 12 countries as well as data on malnutrition rates in a cross-section of countries since the 1970s has been examined. The study used an anthropometric measure-low weight for age-(underweight) of child nutritional status as an outcome of household decisions on health and child care as well as on food consumption. The study tried to observe the extent to which greater resources at the household as well as the national level explain differences in child malnutrition. The study concluded that income growth can play an important part in reducing malnutrition but that it is not enough. It suggeststhat increasing the number and effectiveness of direct nutrition interventions is crucial if nutrition goals are to be met. The estimated fixed effects coefficient on the log of per capita GDP showed that 2.5 percent annual growth in per capita GDPreduces the malnutrition rate by 8 percentage points.Both the cross-country and the household-level results of this study showed that sustained in- come growth could lead to a sizable reduction in malnutrition.

Data and Methodology

The current study is a secondary data analysis of the of the three rounds of India's NationalFamily Health Survey (NFHS 3) conducted in years 1992-93, 1998-99 and 2005-06 respectively. National Family Health Survey is anationally representative household survey measuring indicators of population, health and nutrition, with a special emphasis on women and young children. The primary objective of NFHS is to provide national and state-level data on important indicators of family welfare, household characteristics, maternal health and education, child nutrition and immunization. In all the three rounds of NFHS a separate woman's questionnaire was used to collect information from eligible women about their work status, education, child's health, etc. NFHS-1 surveyed 89,777 ever-married women; NFHS-2 sample covered approximately 90,000 ever-married women and NFHS-3 surveyed both ever married and never married women with total sample size of approximately 1,24,385 women. The sample design adopted in each state in three rounds is systematic with stratified sample of households. The survey used questionnaires, field procedures, and procedures forbiomarker measurements throughout the country to facilitate comparability across the country and to ensure the highest possible data quality.
The main variable of the study is nutritional status of children below 5 years of age. We have used NFHS data on the following three summary indices of nutritional status:

- Weight-for-age (Underweight)
- Height-for-age (Stunting)
- Weight-for-height (Wasting)

Each of the three nutritional status indicators is expressed in standard deviation units (Z-scores) from the median of the reference population. Each index provides differentinformation about growth and body composition. The height-for-age index is an indicator of linear growth retardation and cumulative growth deficits. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered short for their age (stunted) and are chronically malnourished. The weight-for-height index measures

body mass in relation to body length and describe current nutritional status. Children whose Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered thin (wasted) for their height and are acutely malnourished. Weight-for-age is a composite index of height-for-age and weight-for-height. It takes into account both acute and chronic malnutrition. Children whose weight-for-age is below minus two standard deviations(-2 SD) from the median of the reference population are classified as underweight.

Variations in nutritional status by state for all the three years are shown in table 1. During 1991 the best record of nutritional status if found in Kerala but still more than one-quarter of young children are underweight and stunted. Other states with relatively low levels of undernutrition are Manipur, Mizoram, Nagaland and Goa. Nutritional problems are least evident in Sikkim, Arunachal Pradesh, Goa, and Kerala. Even in these states, however, levels of undernutrition are unacceptably high.

NFHS data for year 2005 shows that undernutrition is most pronounced in Madhya Pradesh, Bihar, and Jharkhand. Nutritional problems are also substantially higher than average in Meghalaya and (for stunting) in Uttar Pradesh. Nutritional problems are least evident in Mizoram, Sikkim, Manipur, and Kerala, and low levels of undernutrition are also notable in Goa and Punjab.

The other variable of concern is child mortality.Child mortality rates reflect a country's level of socioeconomic development. NFHS surveyed all women oncomplete history of their births including the sex, month and year of birth, survival status, age at death and then they have calculated 5 estimates of child mortality. In our study, we used the data on Under-five mortality, i.e. the probability of dying before the fifth birthday. We took this as our dependent variable to analyze the impact of mother's education and work status. State wise child mortality is provided in table 2.

The study aims to estimate the effect of mother's education and workforce on child nutrition status and child mortality. Better-educated women are more likely to understand disease-prevention measures and importance of nutritious food and sanitation. All the three rounds ofNFHS contain data onliteracy levels for womenby state.We analyzed the impact of mother's education on child's nutritional status and mortality.

Labour force participation not only gives women an opportunity to earn income, but also exposes them to the outside world and to authority structures and networks. In a developing country such as India, however, where women's workforce participation is often motivated by poverty. The mother's employment status and child health outcome follow a lengthy process with several milestones in between. Work status of mothers is related with child's health and nutritional status through various socio-economic parameters and hence it can impact child's health in either positive or negative way.

Table 1- State-wise percent of Underweight, Stunted and Wasted Children

	Underweight			Stunted			Wasted		
STATES	**1992**	**1998**	**2005**	**1992**	**1998**	**2005**	**1992**	**1998**	**2005**
Arunachal Pradesh	39.7	24.3	32.5	3.6	2	6.1	11.2	7.9	15.3
Andhra Pradesh	49.1	37.7	32.5		1.6	3.5		9.1	12.2
Assam	50.4	36	36.4	1.7	3.3	4	10.8	13.1	13.7
Bihar	62.6	54.4	55.9	4.1	5.5	8.3	21.8	21	27.1
Chhattisgarh			47.1			5.6			19.5
Delhi	41.6	34.7	26.1	2.7	4.1	7	11.9	12.5	15.4
Goa	35	28.6	25	2.4	0.7	5.6	15.3	13.1	14.1
Gujarat	50.1	45.1	44.6	3.7	2.4	5.8	18.9	16.2	18.7

Haryana	37.9	34.6	39.6	0.6	0.8	5	5.9	5.3	19.1
Himachal Pradesh	47	43.6	36.5		3.3	5.5		16.9	19.3
Jammu & Kashmir	44.5	34.5	25.6	3.4	1.2	4.4	14.8	11.8	14.8
Jharkhand			56.5			11.8			32.3
Kerala	28.5	26.9	22.9	1.3	0.7	4.1	11.6	11.1	15.9
Karnataka	54.3	43.9	37.6	2.6	3.9	5.9	17.4	20	17.6
Madhya Pradesh	57.4	55.1	60		4.3	12.6		19.8	35
Maharashtra	54.2	49.6	37	4.2	2.5	5.2	20.2	21.2	16.5
Manipur	30.1	27.5	22.1	1.2	1.8	2.1	8.8	8.2	9
Meghalaya	45.5	37.9	48.8	4.8	1	19.9	18.9	13.3	30.7
Mizoram	28.1	27.7	19.9	0.6	2.8	3.5	2.2	10.2	9
Nagaland	28.7	24.1	25.2	2.3	2.4	5.2	12.7	10.4	13.3
Orissa	53.3	54.4	40.7	3.6	3.9	5.2	21.3	24.3	19.5
Punjab	45.9	28.7	24.9	2.8	0.8	2.1	19.9	7.1	9.2
Rajasthan	41.6	50.6	39.9	5.2	1.9	7.3	19.5	11.7	20.4
Sikkim		20.6	19.7		0.8	3.3		4.8	9.7
Tamilnadu	48.2	36.7	29.8		3.8	8.9		19.9	22.2
Tripura	48.8		39.6	0.7		8.6	17.5		24.6
Uttarpradesh	59	51.7	42.4	2.7	2.1	5.1	16.1	11.1	14.8
West Bengal	56.8	48.7	38.7		1.6	4.5		13.6	16.9

It is important to control for variables that bear a significant impact on child nutrition status and mortality to obtain unbiased estimates for mother's education and workforce status. We control for factors such as sanitation, child immunization, state per capita income and urbanization rate.Access to basic amenities, such as proper housing, safe drinking water and sanitation, and clean cooking fuel, is not only an important measure of the socioeconomic status of the household but is also fundamental to the health of its members. Therefore, sanitation is an important determinant of child health and nutritional status.

NFHS-3 provides information on several household characteristics that affect living conditions like source of drinking water and lighting, type of toilet facility, type of cooking fuel, ownership of a house etc. We took the data on sanitation facility that basically includes information about toilet facility and hygiene.

Table 2- State-wise Child Mortality Rate and Women's Literacy Level (%)

	Child Mortality				Women's literacy levels			
STATES	**1992**	**1998**	**2005**	**AVERAGE**	**1992**	**1998**	**2005**	**AVERAGE**
Arunachal pradesh	72	98.1	87.7	85.93	42.1	47.3	58.1	49.17
Andhra Pradesh	91.2	85.5	63.2	79.97	31.1	36.2	54.6	40.63
Assam	142.2	89.5	85	105.56	40.7	46.1	69.8	52.2
Bihar	127.5	105.1	84.8	105.8	21.7	23.4	37.9	27.67
Delhi	83.1	55.4	46.7	61.73	62.6	70.9	78.6	70.7
Goa	38.9	46.8	20.3	35.33	66.3	71.4	87.3	75
Gujarat	104	85.1	60.9	83.33	44.7	49.7	67.6	54
Haryana	98.7	76.8	52.3	75.93	36.2	44.8	62.4	47.8
Himachal pradesh	69.1	42.4	41.5	51	50.3	63.7	81.5	65.16
Jammu & Kashmir	59.1	80.1	51.2	63.47	43.3	30.2	59	44.16
Kerala	32	18.8	16.3	22.36	84	87.4	96.1	89.16
Karnataka	87.3	69.8	54.7	70.6	38.4	44.8	66.4	49.86
Madhya Pradesh	130.3	137.6	94.2	120.7	25.6	31.5	49.9	35.67
Maharashtra	70.3	58.1	46.7	58.37	49.8	55.4	76.5	60.57
Manipur	61.7	56.1	41.9	53.23	52.4	57.1	78.2	62.57
Meghalaya	86.9	122	70.5	93.13	48.6	61.9	70.5	60.33
Mizoram	29.3	54.7	52.9	45.63	93.4	90	94.4	92.6
Nagaland	20.7	63.8	64.7	49.73	79.9	60.2	78.3	72.8
Orissa	131	104.4	90.6	108.67	32.6	40.5	59.7	44.27
Punjab	68	72.1	52	64.03	47.4	61.2	71.5	60.03
Rajasthan	102.6	114.9	85.4	100.97	17.8	24.5	38.9	27.07
Tamilnadu	86.5	63.3	35.5	61.76	49.9	52.5	78.3	60.23
Uttarpradesh	141.3	122.5	96.4	120.07	24.3	29.8	46.5	33.53
West Bengal	99.3	67.6	59.6	75.5	49.4	50	63.7	54.36

Universal immunization of children against the six vaccine-preventable diseases (namely, tuberculosis, diphtheria, whooping cough, tetanus, polio, and measles) is crucial to reducing infant and child mortality.NFHS collected

information on vaccination coverage for all living children born in the five years preceding the survey. For this study,the variable is measured as fully vaccinated children by state.
Economic growth is measured by increase in gross domestic product and it can alter child health in several ways. Directly, an increase in family's financial resources improves child well-being. Indirectly, governments can use the additional tax revenue that can come from growth to provide services that benefit children and young people. Not surprisingly, poorer states of India showed worst performance when it comes to nutritional status of children under 5 years.

Unlike urbanization in the higher-income countries, which is associated with major advances in science, technology, and social organization as well as absorption of large populations, urbanization in low-income countries has not been accompanied by the same level of economic and cultural progress. Same is the case in India. While the number of people residing in urban India is on the rise, equally alarming is the rise in the number of the urban poor.
The data on urbanization rate and state per capita GDP is obtained from Indiastat.

For the present study, panel data (longitudinal data) has been created.Our study includes 28 states (entities) and three NFHS rounds.Ordinary Least Squares (OLS) estimates are considered to be unbiased and efficient in presence of the assumptions of normality, homoskedasticity and non-autocorrelation. The OLS estimates also serve as the base results in terms of efficiency and biasedness in comparison to alternate forms of estimation. We thus provide OLS estimates to study the effect on child nutrition status of the various parameters under consideration. However, given the panel nature of the data, OLS estimates may be biased due to the presence of state and time specific effects, both fixed and random. We thus derive estimates using both fixed effects and random effects and allow Hausman Test to determine the relevant applicability of the estimates from the two models.
The OLS estimates are derived as per equation (1) below:

$$Child\ Nutrition\ Status_{it} = \alpha_1 Mother's\ Work\ Status_{1t} + \alpha_2 X_{2t} + \ldots\ldots\ldots\ldots + v_{it} \quad (1)$$

where

-X_{2t} represents the vector of controls such as immunization, urbanization rate etc. for state i and time t.

- $v_{it}$is the error term

The fixed effects (FE) estimating equation for child nutrition status is as per equation (2) below.

$$Child\ Nutrition\ Status_{it} = \beta_1 Mother's\ Work\ Status_{1t} + \beta_2 X_{2t} + \ldots\ldots\ldots\ldots + \alpha_i + u_{it} \quad (2)$$

where

-$\alpha_i$is state specific intercept, for state i.

- $u_{it}$is the error term

Similarly, the fixed effects equation for female literacy is represented in equation (3) below.

$$Child\ Nutrition\ Status_{it} = \gamma_1 Mother's Literacy_{1t} + \gamma_2 X_{2t} + \ldots\ldots + \eta_i + \varepsilon_{it} \quad (3)$$

Random effects (RE) are simply the extension of the partial pooling technique as a general-purpose statistical model. An advantage of random effects is that we can include time-invariant variables and the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model: In the fixed effects models these variables are absorbed by the intercept. If we have reason to believe that differences across entities have some influence on our dependent variable then we should use random effects. In this study, we estimated random effects regression equation for women work status which took the form as follows-

$$Child\ Nutrition\ Status_{it} = \delta_1 Mother's\ Work\ Status_{1it} + \delta_2 X_{2it} + \ldots\ldots + \delta_k X_{kit} + \theta + \prod_{it} + \rho_{it} \quad \textbf{(4)}$$

Where

- $\Pi_{it}$is the between entity error

- $\rho_{it}$is within-entity error

Similarly, random effects estimate for mother's literacy are derived as in equation (5) below.

$$Child\ Nutrition\ Status_{it} = \Omega_1 Mother's\ Literacy_{1it} + \Omega_2 X_{2it} + \ldots\ldots + \Omega_k X_{kit} + \kappa + \omega_{it} + \xi_{it} \quad \textbf{(5)}$$

Since the key consideration in choosing between a random effects and fixed effects approach is whether errorsand regressorsare correlated there is a method for testing this assumption known as Hausman's test. Hausman test compares an estimator Θ_1 that is known to be consistent with an estimator Θ_2 that is efficient under the assumption being tested. The null hypothesis is that the estimator Θ_2 is indeed an efficient (and consistent) estimator of the true parameters. If this is the case, there should be no systematic difference between the two estimators. If there exists a systematic difference in the estimates, we have reason to doubt the assumptions on which the efficient estimator is based. We have performed Hausman's test in this study to choose between fixed effects model and random effects model.

Empirical Analysis And Results

Effect of mother's work status on child nutrition

The ordinary least square estimates denoted by OLS, fixed effects estimates denoted by FE and random effects estimates denoted by REhas been compiled for each set of dependent and independent variables. Effect of percent of not working mothers on percent of underweight (weight-for-age below -2sd) children is presented in Table 3.We observed a positive association between percent of not working mothers and percentage of underweightchildren under OLS, FE and RE regression models which indicates that increase in the percentage of not working women results in an increase in percentage of underweight children. Model 1 depicts estimates for linear regression with not working mothers as the only independent variable to estimate for child nutrition status. Additional controls such as urbanization rate and state per-capita income are included along with percent of not working mothersin the following model. Sanitation and vaccination are also controlled for in model 3. FE estimate from column 4 shows percent of underweight children would increase by 0.310 percentage point when percent of non-working mothers increases by 1 percentage point after controlling for time-invariant variables in the model. The coefficient for not working mothers is also significant at 5% under RE model as can be seen in column (7). Thus, supporting our hypothesis that there is a strong linkage between mother's work status and child's nutritional status.

The impact of urbanization is positive and significant under OLS and RE regression as can be seen in column (2) and (8).

Our results show a negative and significant impact (column 2, 5 and 8) of net state domestic product on our dependent variable which is consistent with our hypothesis. We found that sanitation and vaccination are negatively related withpercent of underweight children. Coefficient value of -0.382 (column 6) implies that when percentage of households with sanitation facility increases by 1-unit percentage of undernourished children falls by 0.38 percent.Similarly, RE coefficient -0.0926 (column 9) implies that when percentage of vaccinated children increases by 1 unit, percentage of undernourished children decreases by 0.0926. Hausman p-value for this model is 0.23 which means that RE is appropriate.Results from model 9 therefore suggest an approximate rise of 1% in children being underweight with a percentage rise in non-working mothers. Mothers working status is a close proxy for both education and income status of the family that have both direct and indirect effects on the growth of the child.

Table 3- Effect of percent of non-working mothers on percent of underweight (weight-for-age below -2sd) children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS	OLS	OLS	FE	FE	FE	RE	RE	RE
Not Working	0.0711	0.0803	0.071	.310***	0.0903	0.152	.177**	0.100	0.099*
	(0.83)	(1.09)	(1.3)	(2.81)	(0.84)	(1.56)	(2)	(1.27)	(1.65)
Urbanization		0.273**			-0.630			.249*	
		(2.31)			(-1.45)			(1.68)	
State Domestic Product		-0.002***			-.0013**			-.00182***	
		(-4.25)			(-2.59)			(4.780)	
Sanitation			-0.303***			-.382***			-.316***
			(-9.69)			(-4.35)			(-7.88)
Vaccination			-0.124***			0.00315			-.0926**
			(-3.29)			(0.04)			(-2.09)
N	78	67	78	78	67	78	78	67	78
R-sq	0.009	0.264	0.6180	0.139	0.457	0.44	0.14	0.393	0.41
Hausman p-value							0.0432	0.1352	0.23

* p<.1; ** p<.05; *** p<.01

t/z-statistic in parenthesis

Impact of percent of non-working motherson percent of stunted children is presented in5. We can see thatpercent of not working mothers is positively related to the percent of stunted children like we observed in case of underweight children. The results show significant coefficients under FE and RE (column 4 and 7). Estimates from column (4) indicates that a 1 percent increase in nonworking mothers leads to 0.265 percentrise in of stunted children. The estimates for smother's work status are insignificant for the random effects with inclusion of controls. The Hausman's test however rejects the null hypothesis stating the relevance of FE model. The FE estimates are highly significant and suggest a strong negative impact of non-working mothers on stunted growth of children, The channel is again closely related not only to mother's income as an extra source to family earnings but also her education in meeting adequate nutritional of the child

Table 4- Effect of percent of non-working mothers on percent of stunted (height-for-age below -2sd) children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS	OLS	OLS	FE	FE	FE	RE	RE	RE
Not Working	0.083	0.102	0.104**	0.265***	0.238*	0.281***	0.165*	0.109	0.095
	(1.18)	(1.52)	(2.07)	(3.10)	(2.20)	(2.86)	(92.39)	(1.490	(1.640)
Urbanization		0.128			-0.173			0.011	
		(1.17)			(-0.410)			(0.09)	
State Domestic Product		-0.001***			0.000			-0.0006*	
		(-2.94)			0.11			-1.72	
Sanitation			-0.157***			0.058			-0.127***
			(-5.38)			(0.78)			(-3.51)
Vaccination			-0.208***			-0.056			-0.176***
			(-5.980)			(-0.69)			(-4.08)
N	73	62	73	73	62	73	73	62	73
R-sq	0.019	0.206	0.5270	0.179	0.172	0.195	0.179	0.106	0.073
Hausman p-value							0.047	0.080	0.0008

* p<.1; ** p<.05; *** p<.01

t/z-statistic in parenthesis

Table 5 represents the estimation results of the effect of percent of not working mothers on percent of children who are wasted. Although none of the estimates are significant for not working women butdirectionally coefficients show that percent of not working women has a negative impact on our dependent variable except under FE regression (column 5 and 6). Coefficients of urbanization demonstrate that increase (decrease) in urbanization rate leads to an increase (decrease) in the percent of wasted children.

Estimates for state domestic product is negative indicating a fall in percentage of childre wasted as state per capita income rises. Thus, relationships of urbanization and state domestic product with the dependent variable are compatible with the hypothesis. A rise in state domestic product is an indicator of the economic well-being of the residents which as per theory is a strong deterrent to child malnutrition. Urbanization is associated with provision of technological advancements and facilities in schools, hospitals, infrastructure etc. The coefficient of sanitation under OLS regression (column 3) indicates that a 1 unit change in the percentage of households having sanitation facility leads to 0.113 percent fall in wasted children.

Table 5- Effect of percent of non-working mothers on percent of wasted (weight-for-height below -2sd) children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS	OLS	OLS	FE	FE	FE	RE	RE	RE
Not Working	-0.056	-0.056	-0.068	-0.049	0.001	0.053	0.07	0.000	-0.083
	(-1.180)	(-1.210)	(-1.600)	(-0.600)	(0.010)	(0.630)	(-1.260)	(0.010)	(-1.560)
Urbanization		0.091			0.273			0.273	
		(1.210)			(0.740)			(0.740)	
State Domestic Product		-0.000			-0.000			-0.000	
		(-1.630)			(-0.030)			(-0.030)	
Sanitation			-0.113***			0.057			-0.078**
			(-4.500)			(0.890)			(-2.300)
Vaccination			0.0040			0.189***			0.049
			(0.120)			(2.710)			(1.220)
N	73	62	73	73	62	73	73	62	73
R-sq	0.019	0.071	0.243	0.008	0.030	0.207	0.008	0.000	0.002
Hausman p-value							0.728	0.405	0.000

* p<.1; ** p<.05; *** p<.01

t/z-statistic in parenthesis

Effect of mother's literacy on child nutrition

Table 6 presents estimates of the coefficient of literate mothers and other control variables on percentage of underweight children. Mother's literacy level is seen to have strong positive influence on reducing the probability of children being underweight. Literature suggests that mothers play relatively a more significant role in the upbringing and development of child. Education status of mother is thus key to provision of adequate nutritional needs, hygiene, vaccination etc. in the earlier years of the child. The estimates are highly significant and negative for mother's literacy rate in all the models. OLS estimates in column (2) indicate a .34 percent fall in underweight children. Fixed effects estimate that correct for state and time fixed effects also show a reduction in prevalence of underweight by .25 percent as in model (5). RE estimates in column (7) indicates a fall in percent of underweight children by .37 as proportion of literate mother increases by a percentage point. Hausman test indicates that RE estimates is appropriate for estimating the given equations.

Table 6- Effect of percent of literate mothers on percent of underweight (weight-for-age below -2sd) children

	(1) OLS	(2) OLS	(3) OLS	(4) FE	(5) FE	(6) FE	(7) RE	(8) RE	(9) RE
Literate	-0.394***	-0.346***	-0.054	-0.356***	-0.246**	-0.193**	-0.374***	-0.298***	-0.135*
	(-7.96)	(-5.19)	(-0.70)	(-5.63)	(-2.66)	(-2.04)	(-7.32)	(-4.41)	(-1.78)
Urbanization		0.179*			-0.369			0.181	
		(1.77)			(-0.90)			(1.39)	
State Domestic Product		-0.001*			-0.000			-0.000**	
		(-2.08)			(-1.40)			(-2.42)	
Sanitation			-0.277***			-0.270**			-0.245***
			(-5.42)			(-2.39)			(-4.17)
Vaccination			-0.103**			0.0346			-0.053
			(-2.35)			(0.50)			(-1.12)
N	78	67	78	78	67	78	78	67	78
R-sq	0.455	0.475	0.611	0.393	0.534	0.459	0.390	0.510	0.440
Hausman p-value							0.620	0.550	0.109

* p<.1; ** p<.05; *** p<.01

t/z-statistic in parenthesis

Estimates of **the effect of mother's literacy on wasting among children are presented in table 8. The estimates for mother's literacy though are directionally negative with OLS estimates, are positive with random and fixed effects. Moreover, the coefficients are mostly insignificant.**

Table 7presents estimation results of the effect of female literacy on stunting among children. As can be seen in table the relation of percent of literate mothers with percent of stunted children is significant and negative with OLS and RE estimates.

Coefficients of literate mothers under RE model (column 8) is highly significant and states that when percent of literate mothers increases by apercent, proportion of stunted children decreases by 0.141on average. Coefficients of sanitation and vaccination are significant at 1% under OLS and RE models. Though the estimates under FE are insignificant, however Hausman test is indicative of presence of unobserved random effects. The results thus indicate that literate mothers are less likely to have children with stunted growth.

Estimates of the effect of mother's literacy on wasting among children are presented in table 8. The estimates for mother's literacy though are directionally negative with OLS estimates, are positive with random and fixed effects. Moreover, the coefficients are mostly insignificant.

Estimates of the effect of mother's literacy on wasting among children are presented in table 8. The estimates for mother's literacy though are directionally negative with OLS estimates, are positive with random and fixed effects. Moreover, the coefficients are mostly insignificant.

Table 7- Effect of percent of literate mothers on percent of stunted (height-for-age below -2sd) children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS	OLS	OLS	FE	FE	FE	RE	RE	RE
Literate	-0.271***	-0.291***	-0.019	-0.011	0.035	0.061	-0.161***	-0.141**	0.033
	(-5.95)	(-4.65)	(0.25)	(-0.18)	(0.37)	(0.67)	(-3.27)	(-2.08)	(0.46)
Urbanization		0.056			-0.358			0.019	
		(0.58)			(-0.76)			(0.17)	
State Domestic Product		-0.000			-0.000			-0.000	
		(-0.99)			(-0.47)			(-1.06)	
Sanitation			-0.152***			-0.073			-0.155***
			(-3.05)			(0.69)			(-2.85)
Vaccination			-0.193***			-0.097			-0.186***
			(-4.55)			(-1.11)			(-3.89)
N	73	62	73	73	62	73	73	62	73
R-sq	0.332	0.399	0.498	0.001	0.055	0.049	0.001	0.023	0.039
Hausman p-value							0.000	0.000	0.036

* p<.1; ** p<.05; *** p<.01
t/z-statistic in parenthesis

t/z-statistic in parenthesis

Thus, with the given data \the results are inconclusive for the effect of mother's literacy on percent of wasted children.

Effect of mother's literacy and work status on child mortality

Table 9presents the estimation results of the impact of work status and literacy of mother on child mortality. The estimates show no clear association between child mortality and work status of mother as coefficients for percent of not working mothers are not significant. Although we cannot conclude anything about impact of mother's work status on child mortality, coefficients of other explanatory variables i.e., literacy, sanitation and vaccination are significant and directionally intuitive. The results indicate that mother's literacy is negatively associated with child mortality. In column 1, coefficienton literacy rates ofmothers indicate a 1.15 percentage fall in child mortality. Hausman p-value for this model suggests that RE is appropriate. Under RE,regression coefficient of literacy is -1.073 and is significant at 1% level.

Table 8-Effect of percent of literate mothers on percent of wasted (weight-for-height below -2sd) children

	(1) OLS	(2) OLS	(3) OLS	(4) FE	(5) FE	(6) FE	(7) RE	(8) RE	(9) RE
Literate	-0.066*	-0.036	0.164***	0.101**	0.086	0.061	0.016	0.037	0.129**
	(-1.79)	(-0.73)	(2.74)	(2.03)	(1.14)	(0.86)	(0.40)	(0.69)	(2.06)
Urbanization		0.083			0.133			0.066	
		(1.08)			(0.35)			(0.68)	
State Domestic Product		-0.000			-0.000			-0.000	
		(-1.20)			(-0.47)			(0.90)	
Sanitation			-0.198***			-0.009			-0.152***
			(4.93)			(-0.10)			(-3.17)
Vaccination			-0.054			0.177**			0.002
			(1.56)			(2.57)			(0.06)
N	73	62	73.0000	73	62	73	73	62	73
R-sq	0.043	0.056	0.2930	0.085	0.067	0.213	0.085	0.018	0.002
Hausman p-value							0.003	0.127	0.000

* p<.1; ** p<.05; *** p<.01

Table 9- Effect of percent of not working and literate mothers on child mortality

	(1) OLS	(2) OLS	(4) FE	(5) FE	(7) RE	(8) RE
Not Working	0.167	0.218	-0.270	-0.119	-0.012	0.186
	(1.18)	(1.56)	(-1.10)	(-0.42)	(-0.07)	(1.20)
Literate	-1.155***		-1.213***		-1.073***	
	(-7.79)		(-5.46)		(-6.69)	
State Domestic Product	-0.001*		-0.000		-0.001	
	(-1.87)		(0.48)		(-1.60)	
Sanitation		-0.569***		-1.060***		-0.590***
		(-7.07)		(-4.18)		(-6.23)
Vaccination		-0.750***		-0.315		-0.699***

		(-7.73)		(-1.54)		(-6.36)
N	69	78	69	78	69	78
R-sq	0.632	0.639	0.602	0.44	0.586	0.384
Hausman p-value					0.38	0.111

* p<.1; ** p<.05; *** p<.01

t/z-statistic in parenthesis

Conclusions and Policy Implications

In this panel study, we present an overview of child malnutrition in India and the relation of maternal work status and literacy with nutritional status of children under five years of age It is evident from previous studies that maternal employment and literacy play a vital role in determining nutritional status of children. Under five mortalities among children has also been analyzed in this study with same predictor variables because probability of dying before five is higher among malnourished children.

Our findings suggest that there exists a significantassociation between mother's work status and child nutrition but the way maternal work status affects child nutritional status differs across three indicators of nutritional status. For underweight and stunting, we observed that greater the percent of not working mothers, greater isthe percent of underweight and stunted children and vice versa. For example,the fixed effects coefficient in table 3 showed that when percent of not working mothers changes by 1 percentage point, percentof underweight children changes by 0.31 percentage point. In case of stunting, fixed effects estimates showed that 1 percentage point fall in percent of not working mothers leads to 0.265 percentage point fall in stunted children. In contrast, for wasting we observed that percent of wasted children is lower when percent of not employed mothers is high.

Estimation results of mother's literacy clearly showed that literacy of mother plays a significant role in constraining the levels of malnutrition for child. In case of underweight and stunting regression results indicated that percent of underweight and stunted children fall with increase in the percent of literate mothers. Highly significant random effects estimate showed that percent of underweight children falls by 0.374 units as percent of literate mothers increases by 1 unit. These results reinforce the conclusion thateducation programs for women are vital to child health.However, the results are inconclusive for the effect of mother's literacy on percent of wasted children.
Many efforts have been made by government of India to combat child malnutrition. For example**Integrated child development services scheme (ICDS) scheme**launched in1975has benefitted India's over 100 million persons including children, pregnant women and lactating mothers.There are 7076 projects and 14 lakh Anganwadi centres approved by government of India across the country. **Universal Immunization Programme**launched in 1985 is aimed at providing six childhood vaccines to infants. **Rajiv Gandhi national crèche scheme** launched inJanuary 2006 to provide daycare facilities to children (age group 0-6 years) of working and other deserving women belonging to families whose monthly income is not more than rupees 12000. **The Special Nutrition Programme (SNP)** launched in 1970-71 by the Ministry of Social Welfare to improve the nutritional of preschool children, pregnant and lactating mothers of poor socio-economic groups in urban slums, tribal areas and drought-prone rural areas. There is a big number of such policies aimed at controlling severe malnutrition among children in India but these schemes continue to lag in meeting the defined targets.

In this study, results of the impact of immunization status on child nutritional status and mortality have provided strong evidence in support of our hypothesis. Highly significant and negative association was found between percent of vaccinated children and three indicators of malnutrition. This suggests that vaccination programs,in addition to being a major intervention for reducing child mortality might be considered a tool for mitigating under malnutrition. Thus, efforts should be directed towards improving vaccination coverage to combat malnutrition. In line with the above findings, our study also found that sanitation facility is significant in bringing down child malnutrition. In spite of its significance in determining child nutritional status much less attention has been paid to it.

Another interesting finding from our study was negative impact of urbanization on child nutritional status. Therefore, with the growing focus on the development of urban areas, it is an opportune time for the country's urban planners and administrators to find ways to make our cities child-friendly.

- The National Urban Sanitation Policy 2008 must include 'urban children' as a group that merits special attention.
- Govt should incorporate children's needs in the urban programmessuch as Smart Cities Mission and The Swachh Bharat Abhiyan, by demarcating a budget and conducting focusedsurveysto analyze their concerns.

Finally, state per capita income was also found to have important influence over child nutritional status. Bihar, Uttar Pradesh, Assam and Jharkhand are the poorest states of India and child malnutrition is also very high in these states. Therefore, it is required on the part of government to increase share of development expenditure for poor states and to restore a balance between revenue receipts and revenue expenditures thus, making fiscal situation sustainable.
In summary, this study provide strong evidences that maternal work status, maternal education, sanitation, immunization, urbanization and state per capita income are significant determinants of child nutritional status and child mortality. These variables can cause remarkable improvements in child nutritional status ifendeavored and policies are put in appropriate direction. Current trends, including urbanization, industrialization, migration, and expanding access toeducation have, to some extent, created new opportunities for women. The need foradequate childcare programmes is no longer questioned. The challenge now is to determine howthey can be best implemented.

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