

15/01/2020

Can the Gap between Infant and Child Mortality be explained by Malnutrition Prevalence in India?

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Abstract

Some recent findings indicate malnutrition as the major determinant of death burden among children in India. Although the association between malnutrition and mortality is well established for children below 4 or 5 years of age, exploration of the relation specific to infant or children's age group have remained limited. This issue is crucial considering the wide gaps that are observed between the infant and child mortality rates as well as the disparities between malnutrition prevalence at the relevant age groups of less than 12 months and 12 to 48 months. We consider the National Family Health Survey (2015-16) data from 29 states of India and examine the extent to which the malnutrition burden diverges across age groups and also attempt to link this with the gap between infant and child mortality rates across different states. Our results indicated greater correlation between death burden and malnutrition for the children's age in comparison to the infant age. As regards the burden of infant mortalities, the regression analyses revealed the role of other determinants, viz., women illiteracy, vaccinations, breastfeeding, dietary diversity or per capita income levels across states in India. (Words 177)

Key Words: Under nutrition, Infant mortality, Child mortality, SDG Targets, India.

JEL Code: I10, I14, J13, O20, O53,

Paper for 23rd Annual Conference on Global Economic Analysis
Global Economic Analysis Beyond 2020

Organized by Centre for Global Trade Analysis (GTAP), Perdue University) and National Graduate Institute for Policy Studies (GRIPS)

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1. Introduction:

It has been indicated recently that India could improve upon its overall performance towards achieving the Sustainable Development Goal (SDG) targets, with some major progresses in water and sanitation, power and industry (GOI 2019b). However, it is also pointed out that child malnourishment continues to remain as one of the major problem areas for the country. It may be mentioned that India has remained home to a large proportion of malnourished children with high prevalence of underweight, stunting, wasting and anemia. The recent Global Nutrition Report, 2018 specified Africa and India in having the highest percentage of under-five children who are undernourished (Development Initiatives 2018). The malnutrition of children in India has also been deliberated as the most significant contributor of the under-five mortality in several studies. Incidentally, the recent report on the levels and trends in global child mortality estimates by the United Nations Inter-agency Group has maintained that about half of all under-five deaths in 2018 occurred in five countries, viz., India, Nigeria, Pakistan, the Democratic Republic of the Congo and Ethiopia, while India and Nigeria alone accounted for about a third (UN IGME 2019).

A recent study conducted by the Indian Council of Medical Research (ICMR), Public Health Foundation of India and Institute for Health Metrics and Evaluation, and supported by the Ministry of Health and Family Welfare (GOI) has inferred that malnutrition remains as the leading risk factor for children in every state of India as about two-thirds of the deaths in under-5 children are caused by malnutrition (India State-Level Disease Burden Initiative 2019). It may be recalled that the disaggregate data on infant and child mortality in India suggests that the death burden declines from the infant age (0-1 year) to the age group of 1-4 years. On the other hand, the age distribution of child malnutrition at the all-India level broadly indicates that the rate of under-nutrition prevalence intensifies for the age groups successive to the infant age. The rearrangement of the child malnutrition data from the National Family Health Survey (4th round) in two relevant age groups of less than one year and more than one year but less than 4 year revealed greater prevalence rates at higher age groups. If malnutrition has to remain as the

leading determinant of the children's death burden, then what could be the explanation for this inconsistency that malnutrition prevalence escalates from the infant to the successive age groups while the death burden decelerates between the same two age groups? One would expect that if child malnutrition works as the major element of the death burden, then both should move in the same direction. To the best of our knowledge, this issue has not been dealt with by any researcher. We consider that examining the nature of variations in the infant and child mortalities as well as the malnutrition prevalence at the corresponding age-groups of 0 to 1 year and 1 to 4 years could be a priority research topic for comprehending India's malnutrition challenges. There is a further need to examine the extent to which the child malnutrition and death burden diverges across states of India in the age groups of 0-1 year and 1-4 years.

The main objective of this study is to examine the variations between infant and child mortalities as well as the variations in malnutrition prevalence in the corresponding age groups of 0 to 1 year and 1 to 4 years for different states, and subsequently explore their empirical links by using cross-sectional regression techniques. For this, we first examine the extent to which the child malnutrition and death burden diverges across states in India for the relevant age groups of 0-1 year and 1-4 years. Subsequently, we provide an attempt to locate any differences in malnutrition prevalence between the age groups for different states. The rearrangement of the malnutrition data in relevant age groups could also help us to comment on the role of breast feeding in different parts of the country. The examination of the link between malnutrition and death burden for different age groups are finally carried out by using cross-sectional correlation and regression analysis. Our succeeding analysis proceeds in the following sequences. Section 2 provides an account of the issues relevant for the malnutrition burden in the country. The malnutrition prevalence across individual states is discussed in section 3. For this part, we consider the standard anthropometric indicators of malnourishment, viz., under-weight, stunting, wasting, anemia and obesity for the states of India. We basically examine the difference between infant and child mortalities as well as between malnutrition prevalence at corresponding age groups of 0 to 1 year and 1 to 4 years. Section 4 would deal with the empirical analysis to explore on the nature of relationships between malnutrition prevalence and death burden at the specific age groups of 0 to 1 year and 1 to 4 years. Finally, section 5 would summarize the analysis.

2. Issues in India:

The Indian economy has achieved high economic growth rates; however the common measures child under-nutrition in the country remained among the worst in the world. On the basis of analyzing the NFHS-3 data, Arnold et al (2009) found that almost half of children under age five years (48 percent) remain chronically malnourished in India. The child malnutrition in the country however remains high along with some slow improvements during the past decade. Proper child nutrition as an outcome of development processes in the country and GOI (2017) rightly noted that the resource base of children is being eroded by the malnutrition challenge. When we consider the anthropometric measures of child malnutrition, viz., underweight, stunting and wasting for children below five years of age, one finds that the stunting and underweight prevalence among children below 5 years has gone down from NFHS-3 (2005-06) to NFHS-4 (2015-16). However, the trends in child wasting can be found to register an overall increase during the same time period. The government has recently launched the National Nutrition Mission (POSHAN Abhiyaan) to improve the nutritional outcomes for children, pregnant women and lactating mothers (GOI 2019b). The programme is targeted towards ensuring service-delivery and interventions and lays down specific targets to be achieved across different monitoring parameters over the next few years.

3. Malnutrition Prevalence across States:

India has been trying to address child malnutrition for many decades through various policy initiatives (GOI 2017). However, the different regions or states in India have been found to have progressed at varying degrees in specific malnutrition indicators (India State-Level Disease Burden Initiative 2019, GOI 2019a). In this paper, we split up the concentration of under-nutrition in all the states among children of age-groups that is relevant for the infant and child mortality rates. For this, we reclassify the malnutrition prevalence and define two specific age-groups, viz. children less than 12 months of age and children between the age of 12 to 48 months. This data is provided in Figure 1 reveals that malnutrition rates are higher in the latter age group for many states.

(Insert Figure 1 here)

Figure 2 provides a comparison of the infant and child mortality rates across various states so as recognize any link between the malnutrition and death burden. The data provided in the figure reveals that infant mortality rates has remained at much higher levels than the child mortality rates for the majority of the states.

(Insert Figure 2 here)

4. Methodology:

The objective of our empirical analysis is to examine how has the malnutrition prevalence impacted on the death burden for the two different age groups, viz. 0 to 1 year and 1 to 4 years. We attempt correlation and regression analysis along with other control variables and estimate the following model using cross-sectional observations from 31 states and union territories of India

$$\text{Mortality Rate} = \alpha + \beta_1 \text{Malnutrition} + \text{Control Variables} \quad (1)$$

The control variables are picked up from mothers with no schooling, all age appropriate vaccinations, median duration of predominant breastfeeding, minimum dietary diversity, and per capita net state domestic product as a measure of per capita income in the state.

5. Data Base:

The basic data is gathered from the most recent National Family and Health Survey, Fourth Round, (2015-16) brought out by the International Institute for Population Science, Mumbai on behalf of the Ministry of Health and Family Welfare, (GoI).

6. Results:

The relationships between the mortality rate and underweight prevalence - each referring to the appropriate age group, viz., 0 to 11 months and 12 to 48 months - to capture the link between underweight prevalence and infant or child mortality rates are graphically represented through a scatter-plot of observations on all the 29 states plus all-India, along with the information on

correlation coefficient (Figure 3 and Figure 4). We observe a moderate positive correlation in both cases, but the relationship remains stronger for the child mortality in comparison to the infant mortality. This would indicate that death burden to rise along with growing underweight prevalence. The weak relationship between infant mortality rate and underweight prevalence could be a pointer to the importance of other determinants, viz., mother's literacy, vaccination, duration of breastfeeding, dietary diversity, per capita income, etc.

(Insert Figure 3 and 4 here)

In figure 5 and 6, we portray the relationships between the mortality rate and prevalence of stunting, again referring to the appropriate age group of 0 to 11 months and 12 to 48 months, respectively. We again find that the correlation to remains stronger for the child mortality in comparison to the infant mortality with the age appropriate stunting prevalence.

(Insert Figure 5 and 6 here)

Finally, the relationships between the mortality rate and prevalence of wasting of children referring separately for the age groups: 0 to 11 months and 12 to 48 months, respectively are provided in figure 7 and 8. The correlation for the child mortality with wasting to remains stronger in comparison to the correlation for the infant mortality with wasting of children.

(Insert Figure 7 and 8 here)

The regression results obtained from estimating equation (1) for examining the determinants of infant and child mortality rates are provided in Table 1 and Table 2, respectively. Since the OLS estimation generated autocorrelation problem as evident from the low Durbin-Watson test statistic, we have provided the results from Cochrane-Orcutt estimation after correcting the serial-correlation problem. The explanatory variables that turn out to be statistically significant bear correct signs in all the equations.

In Equation (1b), the lack of schooling for women positively contributed to the infant as well as child mortality. On the other hand, appropriate vaccinations, breastfeeding, dietary diversity and per capita income in the state worked against both infant and child mortality. We have tried alternate specification after dropping per capita income in Equation (2). Subsequently, we have dropped dietary diversity from the determinants of infant mortality or the role of

breastfeeding from the determinants of child mortality in Equation (3). It may be observed that the role of underweight infants failed to reveal any significant statistically significant effect in any of the equations. On the other hand, the prevalence of underweight children indicated some impact on lower levels of statistical significance. Our results largely suggest that while the prevalence of underweight children could have contributed towards the rise in child mortality, there are other variables, viz., women illiteracy, vaccinations, breastfeeding, dietary diversity or per capita income, which could have played a role in determining the growth of infant mortality rates in India.

(Inset Table 1 and 2)

7. Summary:

India faces some major challenge in ensuring the nutritional security on account of all the three pillars, viz., availability, accessibility and absorption or nutritional outcomes (Deaton and Drèze 2009, Nandakumar et al 2010, Saxena 2011, Ravi and Singh. 2016). In recent times, Pingali and Abraham (2018) estimated that malnutrition rates in India remain poorer in comparison to countries and regions with similar and even lower income levels. Thus, countries in Africa south of the Sahara and South Asia are found to reveal better performance in child malnutrition indicators. Swaminathan et al (2019) recently derived estimates of child malnutrition indicators from the NFHS-4 data for the 543 parliamentary constituencies in India and inferred that several constituencies experience multiple burdens of child malnutrition that must be addressed straightway. The achievement of SDG targets remains crucial for India's development on which the ending of child malnutrition remains an important component of SDG. However, there have been some doubts whether India can achieve the child malnutrition targets. The results of this paper can provide useful insights on the child wellbeing status of India.

This paper had the task of examining whether malnutrition remains as the leading determinant of the death burden specific to the age group of infants (less than 12 months) and children (12 to 48 months). Our rearrangement of age-specific malnutrition data indicated that although the prevalence of malnutrition (underweight, stunting or wasting) sets in during the infant age (0 to 11 months), it increases at the age-group of children (12 to 48 months). Our correlation evidence between death burden vis-à-vis underweight, stunting or wasting prevalence remains more prevalent for the children's age in comparison to the infant age. The regression

exercises suggest that role of other factors, such as, women illiteracy, vaccinations, breastfeeding, dietary diversity or per capita income for the infant mortality prevalence rates across states in India.

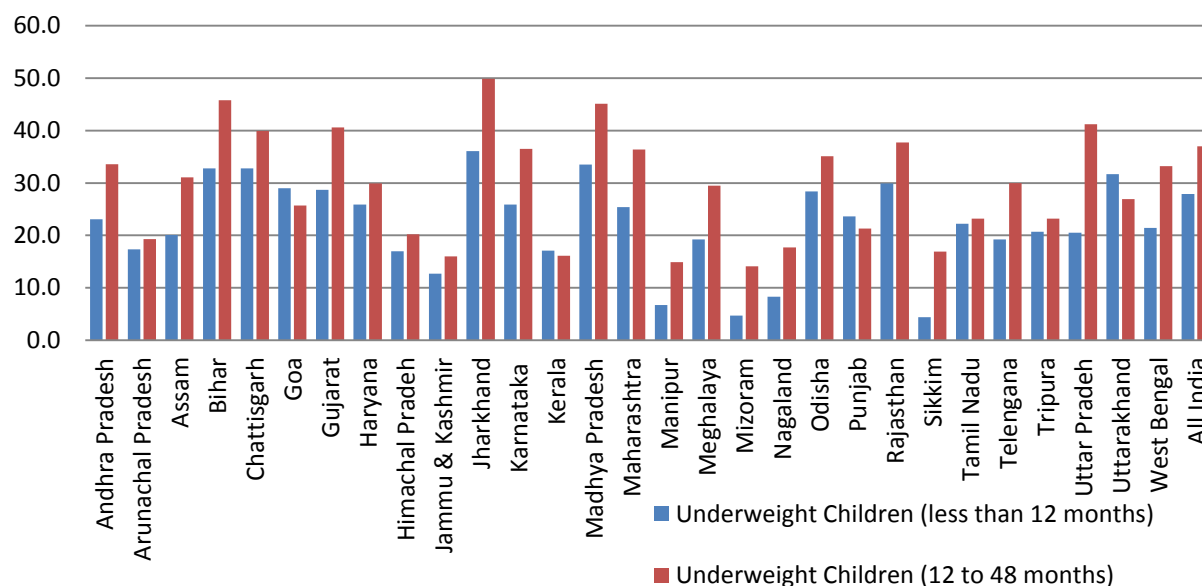
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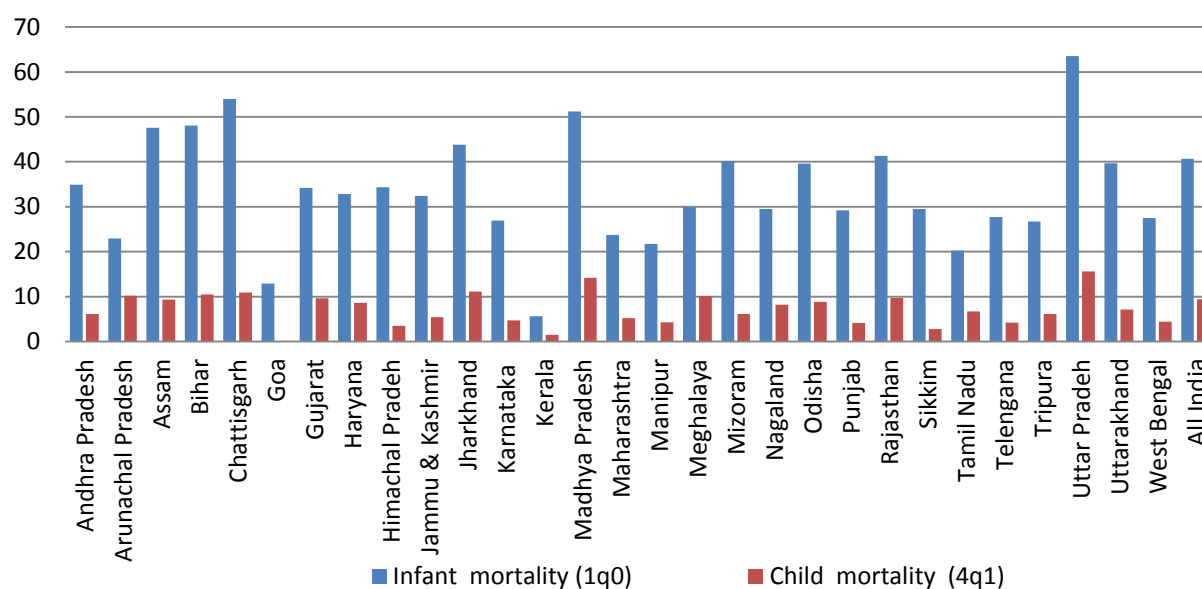
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Figure 1: Percentage of Underweight Children at Different Age Groups in States of India.



Source: IIPS (2017): NFHS-4.

Figure 2: Infant and Child Mortality in Different States of India, 2015-16.



Source: IIPS (2017): NFHS-4.

Figure 3: Infant Mortality and Prevalence of Underweight Children.

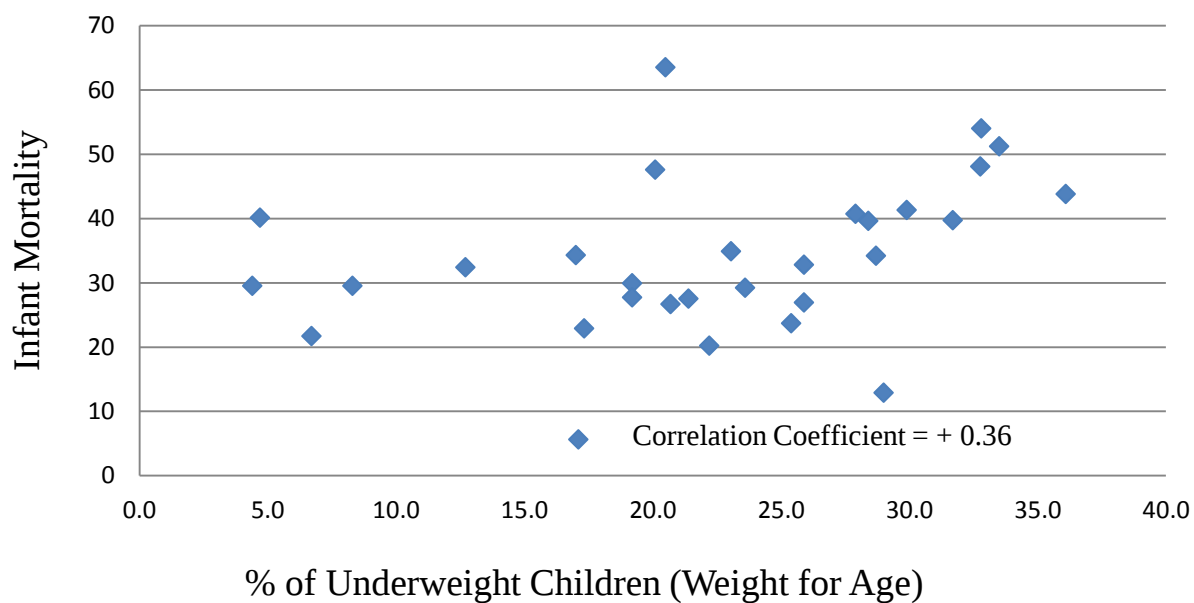


Figure 4: Child Mortality and Prevalence of Underweight Children.

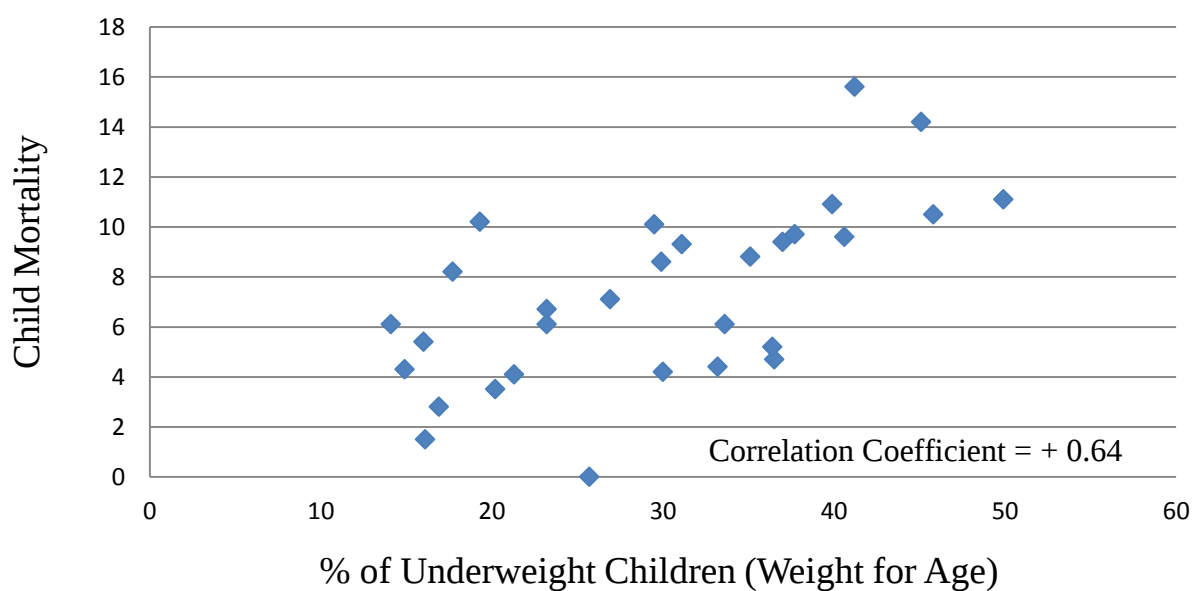


Figure 5: Infant Mortality and Prevalence of Stunted Children.

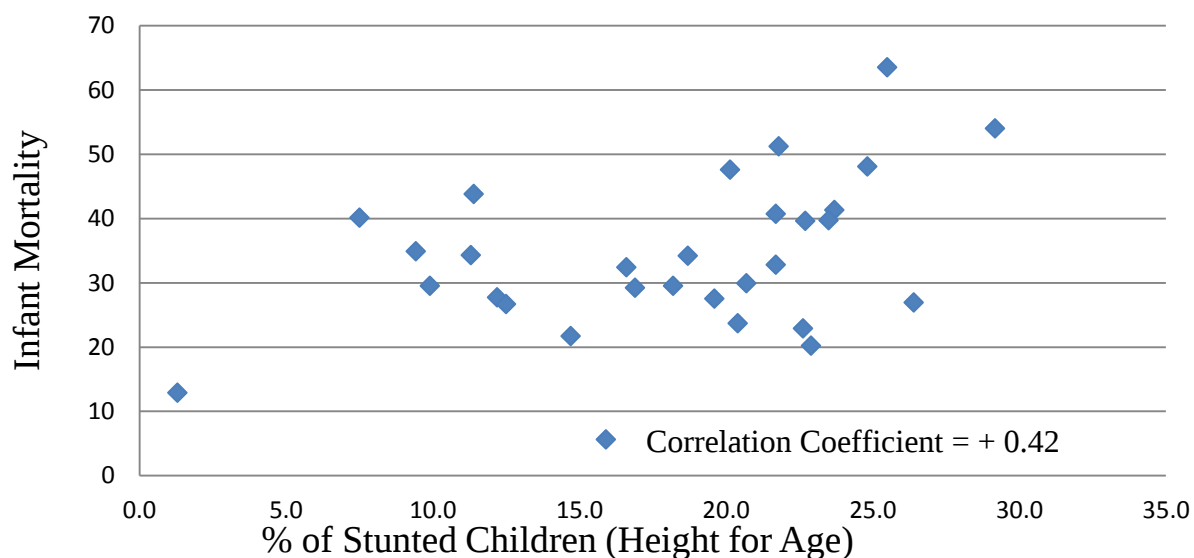


Figure 6: Child Mortality and Prevalence of Stunted Children.

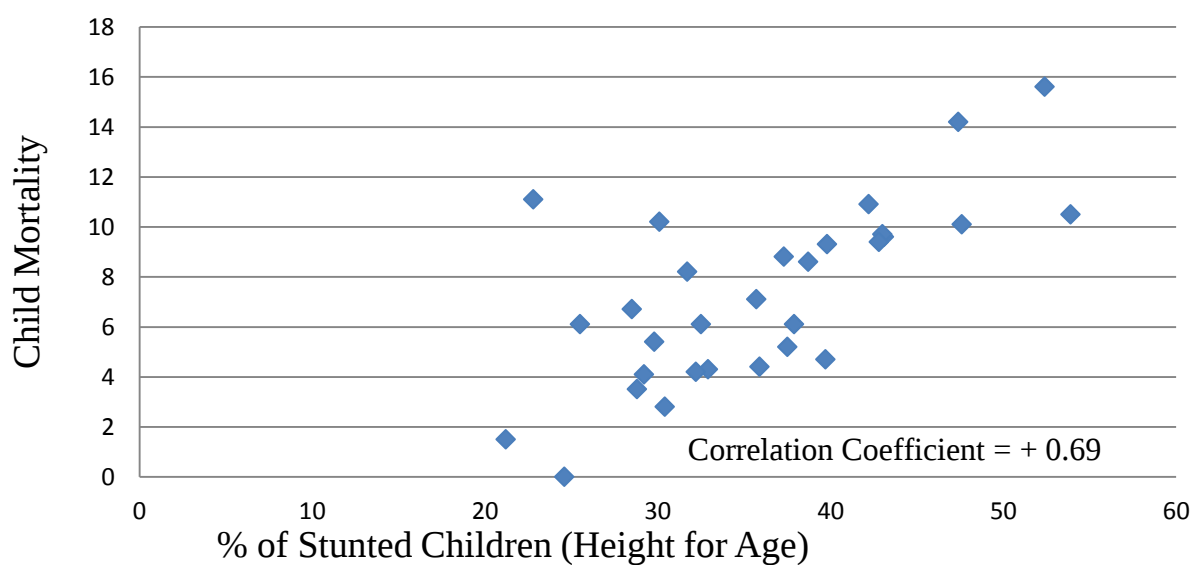


Figure 7: Infant Mortality and Prevalence of Wasted Children.

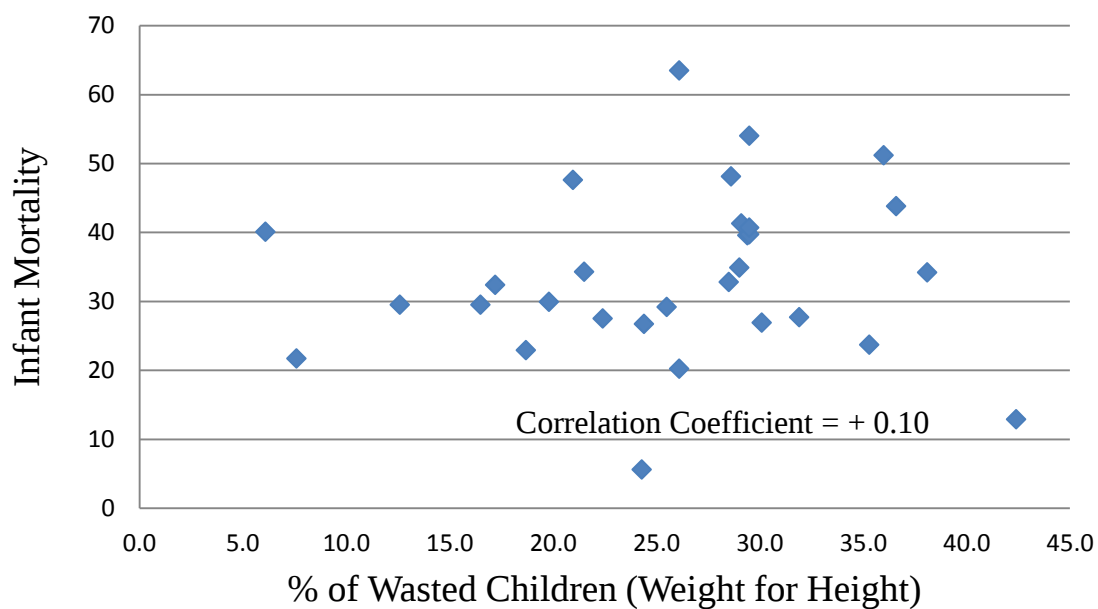
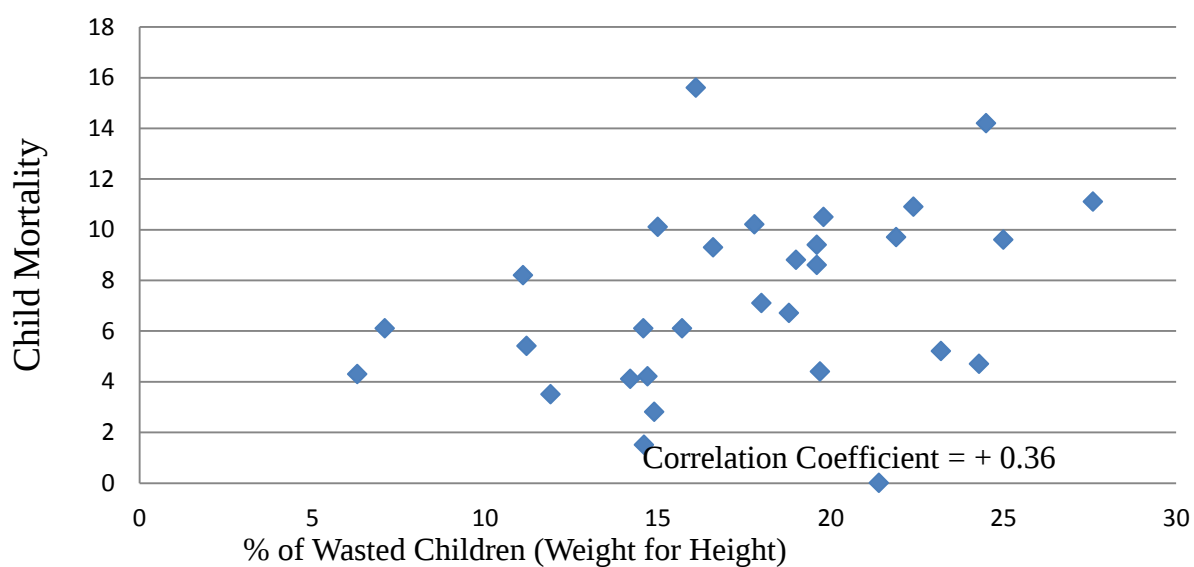


Figure 8: Child Mortality and Prevalence of Wasted Children.



**Table 1: Regression Results: Dependent Variable: Infant Mortality Rate, 2015-16
(Sample: 29 States plus All-India).**

	Dependent Variable: Infant Mortality Rate					
<i>Explanatory Variables</i> ↓	OLS (1a)	Cochrane- Orcutt (1b)	OLS (2a)	Cochrane- Orcutt (2b)	OLS (3a)	Cochrane- Orcutt (3b)
Constant	5.43 (2.46)	5.79 (2.97)	4.12 (1.90)	5.69 (2.92)	1.44 (1.20)	2.06 (1.75)
% of Children (less than 12 months) who are underweight as per weight for age	-0.19 (0.64)	-0.25 (0.79)	-0.25 (0.79)	-0.25 (1.04)	0.01 (0.01)	-0.10 (0.39)
% of Women (age: 15-49) with No Schooling	0.43 (1.96)	0.62 (2.64)	0.60 (2.88)	0.73 (3.75)	0.60 (2.79)	0.76 (3.58)
% of Children (age 12-23 months) who received all Basic Vaccinations	-0.01 (0.10)	-0.06 (0.50)	-0.10 (1.01)	-0.11 (1.26)	-0.12 (1.14)	-0.15 (1.66)
Median Duration of Predominant Breastfeeding	-2.02 (0.69)	-3.49 (1.29)	-1.09 (0.36)	-3.85 (1.25)	1.42 (0.57)	0.32 (0.11)
% of Children (age 6-23 months) with Minimum Dietary Diversity	-0.42 (1.75)	-0.46 (1.94)	-0.36 (1.46)	-0.45 (1.95)		
Per capita Net State Domestic Product in States at Current Prices (Triennium ending 2015-16)	-0.01 (1.79)	-0.01 (0.83)				
R-Squared	0.56	0.67	0.51	0.66	0.46	0.58
R-Bar-Squared	0.45	0.49	0.40	0.51	0.37	0.46
DW Statistic	2.22	1.92	2.23	1.97	2.18	1.94
F-Statistic	5.01	3.87	4.92	4.33	5.37	4.87

Note: * and ** indicate statistical significance at 5% and 20% level of significance, respectively.

**Table 2: Regression Results: Dependent Variable: Child Mortality Rate, 2015-16
(Sample: 29 States plus All-India).**

	Dependent Variable: Child Mortality Rate					
<i>Explanatory Variables ↓</i>	OLS (1a)	Cochrane- Orcutt (1b)	OLS (2a)	Cochrane- Orcutt (2b)	OLS (3a)	Cochrane- Orcutt (3b)
Constant	0.85 (1.54)	1.12 (2.87)	0.49 (0.80)	1.17 (2.89)	0.30 (1.13)	0.82 (3.52)
% of Children (less than 12 months) who are underweight as per weight for age	0.11 (1.54)	0.03 (0.58)	0.10 (1.42)	-0.01 (0.20)	0.11 (1.50)	-0.01 (0.13)
% of Women (age: 15-49) with No Schooling	0.08 (1.40)	0.08 (1.92)	0.12 (2.11)	0.13 (3.19)	0.12 (2.10)	0.12 (2.98)
% of Children (age 12-23 months) who received all Basic Vaccinations	-0.05 (-2.03)	-0.05 (-2.56)	-0.03 (3.24)	-0.09 (5.48)	-0.08 (3.28)	-0.08 (5.33)
Median Duration of Predominant Breastfeeding	-0.53 (0.75)	-0.49 (-0.89)	-0.29 (0.40)	-0.60 (1.03)		
% of Children (age 6-23 months) with Minimum Dietary Diversity	-0.01 (-0.28)	-0.06 (-1.44)	0.01 (0.05)	-0.07 (1.73)	0.01 (0.38)	-0.05 (1.35)
Per capita Net State Domestic Product in States at Current Prices (Triennium ending 2015-16)	-0.01 (-1.84)	-0.01 (-2.05)				
R-Squared	0.70	0.83	0.65	0.79	0.65	0.77
R-Bar-Squared	0.62	0.75	0.58	0.71	0.60	0.71
DW Statistic	2.18	1.78	2.18	1.71	2.15	1.68
F-Statistic	8.88	11.23	9.06	10.46	11.67	11.97

Note: * and ** indicate statistical significance at 5% and 20% level of significance, respectively.