

Child Undernutrition in India: Age-wise Trend and Risk Factors

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Abstract

Three studies in India which have analysed the raw data of national and state nutrition surveys are presented. The emerging findings with reference to age-wise trend of undernourished children under- five years of age is described along with the result of the statistical regression analysis of risk factors. The implications of the findings of statistical analysis using raw data of surveys provide evidence for programme directions and indicate the need for revisiting the current nutrition programme designs in the country. There is an urgent need for an explicit policy for improving nutrition of women through multidimensional approach.

Keywords: Child undernutrition, age-wise trends, risk factors

1. Introduction

India, along with Bangladesh and Pakistan, contribute to almost half of the total burden of child underweight in the world (UNICEF, 2013). To date, three National Health and Family Surveys (NFHS 1, NFHS 2 and NFHS 3), undertaken in 1992-93, 1997-98 and 2005-6, present data on nutritional status of women and children in India (NFHS-1,1993; NFHS-2 1999 and NFHS-3, 2006). Besides these three national surveys, there are some state level small and large surveys. The only large state level survey was undertaken at state level in the state of Uttar Pradesh in 1995. This study was undertaken by the Institute of Applied Statistics and Development Studies (IASDS) for the Department of Women and Child, State Government of Uttar Pradesh (UP) with the support of UNICEF (DWCD, GoUP, 1999). The UP state survey was also the first survey where a statistical analysis of raw data was undertaken for understanding the association of various determinants with undernutrition in children under five years. In this context, immediate, underlying and basic causes of child undernutrition, as presented in the UNICEF conceptual framework of undernutrition (were selected and studied along with analysis of age-wise trend of undernutrition and regression analysis of the risk factors of undernutrition (UNICEF, 1998). In 2011-12#, the National Institute of Medical Statistics (NIMS) of the Indian Council of Medical Research and Public Health Nutrition and

The complete findings of this study is presented as a paper entitled "Undernutrition in Children Under Two Years : An Analysis of Determinants, by Tulsi Adhikari, Sheila C. Vir, R.J. Yadav, Arvind Pandey" in this Special Issue of 2015 on Statistical Concerns in Child Health and Nutrition"

Development Centre, New Delhi analysed the raw data of NFHS 3 to statistically examine the association of important possible determinants with undernutrition in children under two years as well as prioritized the risk factors and assessed the age-wise prevalence of undernutrition in under five years children (Adhikari, et al., 2012). This was followed by a similar study for the Southern States of India using the raw data of NFHS 3 for Andhra Pradesh, Kerala, Karnataka and Tamil Nadu (Adhikari T and Pandey A, 2014). The findings of these three studies are presented with focus on the age wise trend in undernutrition trend and highest risk factors of undernutrition in under five years and under two years children.

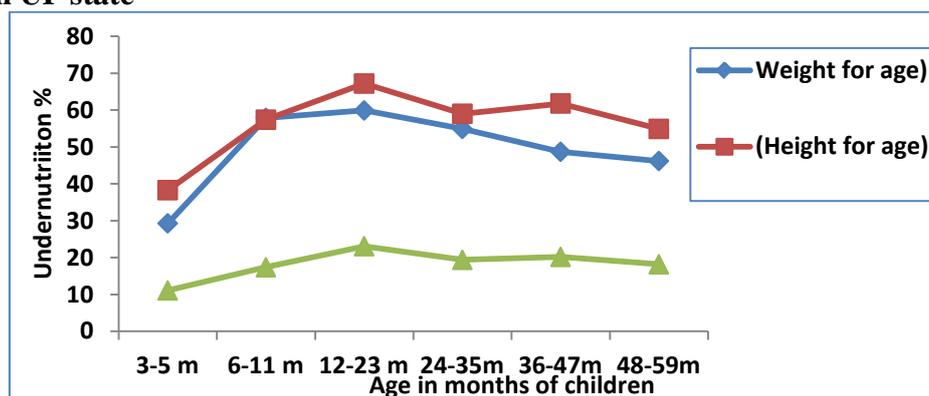
Statistical Analysis of Raw Data of National and State Surveys and Emerging Findings: An Overview

The results of each of the three following studies is presented (a) The Nutritional Status of Women and Children in Uttar Pradesh, 1995 (reported in January 1999; DWCD, GoUP 1999) (b) Undernutrition Among Children Under Two Years in India: An Analysis of Determinants (Adhikari, et al., 2012) and (c) Undernutrition Among children under-two years in southern states of India: an examination of prevalence and risk factors 2013-2014 (Adhikari T and Pandey P, 2014).

a) The Uttar Pradesh (UP) survey was undertaken region-wise and the sample comprised 8070 women and 6113 children under 5 years (DWCD, GoUP 1999). The underweight (weight for age) prevalence rate of in under five children in the state was noted to be 52.0 percent while 59.3 percent suffered from stunting (height for age) and 19.5 percent from wasting (weight for height). A third of women (29.7 percent) had BMI less than 18.5 while 14.1 percent had height less than 145 cm and 47.9 percent had weight less than 45 kg.

An analysis of the age-wise prevalence rate of undernutrition in children revealed that the prevalence rate of malnutrition varied substantially according to age of children. Twenty nine percent children were underweight at 3-5 months of age. Prevalence of malnutrition accelerated after 5 months and about 60 percent children were underweight by the age of 12-23 months. The underweight percentage was between 55-60 percent throughout 6-35 months, followed by significant decline in the prevalence rate in the age group 35-47 months and 48-59 months. In terms of stunting, 38.3% children in the age group of 3-5 months were stunted with a sharp increase to 67.2 percent between 12-23 months. The prevalence decreased to 59.0 percent at 24-35 months and decreased to 54.9 percent by 48-59 months (figure 1) (NFHS-3, 2006). The data provides evidence that the first 24 months are most crucial for prevention of undernutrition.

Figure 1: Age-wise trend in prevalence rate (percentage) of underweight, stunting and wasting in UP state



Source: NFHS-3 (2005-06)

An association of undernutrition with the following factors, in varying degrees, was noted -1) child's age 2) age at introduction of complementary feeding 3) prevalence of diarrhoea, measles and ARI during the last 15 days 4) level of education of mothers 5) mother's BMI 6) care taken by mothers during the last three months of pregnancy and 7) type of house and toilet. Following the analysis of association of these factors with undernutrition in children under five years of age, the associated relative risks of these determinants was further examined by the logistic regression analysis. This procedure was adopted since it had the advantage that it evaluated the impacts in terms of their relative risks (factor loadings). The analysis was carried out for each of the following three undernutrition indicators--weight for age (underweight), height for age (stunting) and weight for height (wasting). Comparison were made i) between severely malnourished (less than -3SD times reference median) and normal children to capture maximum variability that exists between the two populations of children and ii) malnourished (less than -2SD times reference median) and normal children. Moreover, child's age, though a continuous variable, was also taken in the binary form of 12-35 months versus other ages because malnutrition was noted to be maximum between 12-35 months. The factors were regrouped into broad categories as presented in Table 1 and were converted into binary codes to run the logistic regression.

Table 1: Risk Factors Selected for logistic regression

Binary form of variables	Variables
Child's age	Children of 12-35 months (1), others (0)
Hygiene	Children with kutcha households with no facility and inadequate drainage (1) and others (0)
Disease	Children suffering from any of the diseases –diarrhoea ,measles and ARI (1), others (0)
Care	Children whose mothers took better care diet and more rest and did less heavy work during the last three months of pregnancy (1), Others (0).
Literacy	Children of illiterate mothers (1), others (0)
BMI	Children of mothers with BMI <18.5(1), others (0)
Complementary feeding	Children which were introduced to complementary feeding at 4-6 months** (0), others(1)
Immunisation	Immunised (0), not immunised (1)

**the earlier recommended policy for the time of introduction of complementary feeding to infants was 4-6 months and not the current policy of 6 months.

The preliminary analysis revealed that the factor loadings for both age at introduction of complementary feeding and immunisation were less than one and were not significant. The impact was probably not observed since only the age of introduction of complementary feeding was the indicator used while it is now well known that issues of food diversity, quantity and frequency are crucial and cannot be ignored while studying the association with complementary feeding. These variables were excluded in the subsequent analysis.

Table 2 presents the emerging risk factors along with their loadings noted for underweight, stunting and wasting (<-2SD). Mother's body mass index (BMI) is observed to be a risk factor across all the three measures of undernutrition. Hygiene is noted to be a risk factor with a loading of 1.19 for stunted children under five years confirming the long term implications of poor access to hygiene and possibly sanitation on stunting.

Table 2: Risk factors and their loadings (Undernutrition-2SD) in Uttar Pradesh

Underweight		Stunting		Wasting	
<i>Risk Factor</i>	<i>Factor Loading</i>	<i>Risk factor</i>	<i>Factor Loading</i>	<i>Risk Factor</i>	<i>Factor Loading</i>
BMI	1.63	BMI	1.30	Disease	1.64
Disease	1.58	Literacy	1.27	BMI	1.29
Child's age	1.41	Child's age	1.26	Child's age	1.19
Literacy	1.28	Hygiene	1.19	Literacy	1.17

Regarding severe undernutrition, as presented in Table 3, literacy of mother emerged as the most important risk factor with the highest factor loading of 2.04 i.e. the risk of severe underweight is 2.04 times higher among children of illiterate mothers compared to literate mothers. In case of severe stunting, the highest risk loading factor was again pertaining to literacy of mothers with a loading factor of 1.84. The variable hygiene which is a composite variable for the type of house, toilet and drainage emerged as an important contributing risk factor for stunting indicating the long term impact of the determinant.

Table 3: Risk factors and their loadings (severe malnutrition -3SD) In Uttar Pradesh

Underweight		Stunting		Wasting	
<i>Risk Factor</i>	<i>Factor Loading</i>	<i>Risk factor</i>	<i>Factor Loading</i>	<i>Risk Factor</i>	<i>Factor Loading</i>
Literacy	2.04	Literacy	1.84	Care	1.83
Child's age	1.79	Child's age	1.61	Disease	1.57
Disease	1.75	Hygiene	1.28	BMI	1.55
BMI	1.74	BMI	1.26	Literacy	1.39
Care	1.50			Child's age	1.31

The analysis also provides evidence that prevention and control is not limited to dietary intake but is a multi-dimensional problem. Women's education and her anthropometric status were found to have the highest loading factors.

b) The second study, undertaken by NIMS, the 1998-99 NFHS2 data was converted using the WHO 2006 standard for Assessment of nutritional status for comparison with 2005-6 survey findings. The prevalence rate of underweight in children below two years was noted to be 37.2 percent in 2005-6 compared to 38.7 percent in 1998-99. The prevalence rate of stunting, however, showed a statistically significant decrease in under two children---40.2 percent in 2005-6 compared to 49.5 percent in 1998-99.

Month-wise trend analysis of 19,443 children, using raw data of NFHS 3 of under five years children, indicated about 35 percent children were underweight at birth or zero month and there was a steady increase to over 50 percent by two years of age. There was no further increase but age wise prevalence indicates two peaks in prevalence of underweight—22-24 months and 34-36 months. Month-wise prevalence of stunting rates in children (n=21914), however, indicated a continuous increase in the stunting rate in the first 22 months and then the prevalence rate was noted to become steady thereafter. Almost a third was found to be stunted at birth with steady increase up to 22-24 months of age with over 70 percent children stunted. Stunting occurring under two years is largely irreversible. On the other hand, wasting rates in children were found to decline sharply -around 45 percent at two months to about 20 percent by 24 months of age.

Two major steps were followed for studying the risk factors associated with undernutrition in children under two years of age. Bivariate analysis was performed to test the association of between categories of undernutrition and selected risk factors. The significant variables (p value<0.05) observed in this bivariate analysis were subsequently used in multivariate analysis. A linear logistic regression analysis was applied for multivariate analysis. The various possible risk factors (determinants) studied in the analysis are presented in Table 4. The multivariate logistic regression analysis has been applied to examine the association of various risk factors with the undernutrition in under two children, after eliminating the confounding effect.

Table 4: Risk factors of undernutrition Studied for regression Analysis

Determinants				
<i>Infant and young child feeding practices</i>	<i>Nutritional status of mothers and birth parameters</i>	<i>Environmental Factors</i>	<i>Health Services</i>	<i>ICDS Services</i>
Children breastfed(BF) with one hour of birth, Infants fed colostrum*	Women married by 18 years**	Toilet facility **	Child Immunization@	Supplementary food To 6-24 months child* Supplementary food to pregnant mothers #
Exclusively BF	Height of mothers below 145cm,** Body Mass index ,	Safe drinking water**	Antenatal services check - up**	Weighing of children#
Children during diarrhoea given less	Low birth weight,** birth intervals#	Standard of living**	Institutional births**	Health check -up under ICDS*
	IFA Tablets at least 90**		Consumption of IFA tablets **	Health and nutrition education**
	Education status**, domestic			

food @	violence**			
	Exposure to mass media – watching television**, listening to radio**			

association of both underweight and stunting non –significant.* significant association with underweight and not stunting ** significant association with both underweight and stunting @

The risk factors found to be associated with high prevalence rate of underweight of undertwos pertains primarily to status of mothers, viz., height of mother less than 145 cm had around double the risk of undernutrition in under twos than the mothers with height more than 145 cm; mothers with no education had 1.8 times more risk of having underweight-under two children than the literate mothers; mothers who did not go for institutional delivery had 1.4 times more risk than the mothers otherwise; mothers who did not have the exposure of watching TV at least once a week had 1.4 time risk than the mothers who watch TV at least once a week. Mothers who experienced emotional violence also were at higher risk of being underweight as well as mothers who did not consume IFA tablets for at least 90 days, and mothers living in households with no toilet facility were also at higher risk of having underweight children

Table 5: Risk of Underweight and Stunting in Children (Odds Ratio) under Two Years in India

Risk of Underweight and Stunting in Children (Odds Ratio) under two years	
<i>Risk of underweight in Under two children</i>	<i>Risk of Stunting in Under two children</i>
Height of mothers <145 cm =1.965	Mothers with no education = 1.647
Mothers with no education=1.812	Height of mother < 145 cms = 1.643
Mothers who did not have institutional delivery=1.374	Mothers who did not have institutional delivery = 1.386
Mothers who did not watch television at least once a week = 1.35	Households with low standard of living = 1.346
Households with no toilet facility = 1.345	Households with no toilet facility = 1.245
Mothers who experienced emotional violence = 1.317	
Mothers who did not consume IFA tablets for 90 days or more = 1.216	

Regarding prevalence rate of stunting in undertwos, mothers with no formal education or mothers who had height < 145 cm had 1.6 times more risk than the other mothers. Similarly, mothers with no institutional delivery were at 1.4 times higher risk of having stunted children under two years. Mothers who were living in household with no toilet facility or with low standard of living had higher risk of having stunted children.

c) The third study on age trend and risk factor is reported by NIMS for four southern states. The prevalence rate of underweight in these four states is much lower than the all India

prevalence rates of underweight of 38.7 percent and 40.2 per cent stunting for undertwos. State-wise prevalence rate of underweight in Andhra Pradesh was 21.2 percent while it was less than 20 percent in others- Karnataka 19.4 percent, Kerala 17.5 percent and Tamil Nadu 18.9 percent. Stunting rates in undertwos in the southern states was observed to be almost half of the national average of 40.2 percent. The prevalence rate of stunting being 24.7 percent for Andhra Pradesh, 23.7 percent in Karnataka, 23.2 percent for Kerala and 23.5 percent for TN.

The raw data of NFHS 3 survey was analysed for age trend and risk factors. The methodology used was identical to the one described under (b) for the all India study undertaken by NIMS and PHNDC.

The month-wise trend in prevalence rate of underweight showed a continuous increase up to 24 months to around 40 percent rate and then stabilization in underweight prevalence rate. Stunting prevalence rates also was found to increase with increase in age. About a third of under-two years children were observed to be stunted by two months of age and the highest prevalence rate was observed by two years of age.

The multivariate logistic regression analysis was applied to see the association of various risk factors with both underweight and stunting in children undertwos, after eliminating the confounding effect. As presented in Table 6, the factors pertaining to status of mothers seem to be the most prominent risk factors. LBW or low birthweight (<2500 grams) and education of mothers was noted to be the common risk factors for both underweight and stunting rates in undertwos children. Mothers with no education had 1.3 times risk of having underweight children than the literate mothers while mothers with no formal education had 1.2 times more risk of having stunted children. Mothers who had height < 150 cms had 2.2 times more risk of having stunted children than the other mothers.

Table 6: Undernutrition in children under twos and risk factors (Odds Ratio) in Southern States of India

<i>Underweight</i>		<i>Stunting</i>	
Factors	Odds Ratio	Factors	Odds Ratio
		Height of mother <150 cm	2.166
Low Birth weight	2.9	Low Birth weight	1.534
Mothers with no education VS high education	1.269	Mothers with no education VS high school and above	1.243
		Households with lowest standard of living index	1.161

2. Discussion

The age trend of undernutrition and regression analysis emphasise the significance of focussing the programme interventions in the first 1000 days of life—from conception to 24 months of age. World-wide growth faltering analysis using WHO standards stress the significance of prenatal and early life interventions to prevent growth failure occurring in the first two years of life (De Onis, et al. 2006). The findings of India study concur with the recommendation of World Bank report on India and of Lancet Nutrition series 2008 of the need to accord priority and concentrate on the critical window of opportunity from

conception to 24 months of age (Gagnoli, et al. 2005 and Black, et al., 2008). In fact, intensifying preventive measure in the first 92 weeks i.e. from conception to 12 months is imperative for universal coverage of a minimum four ANC check-ups, immunisation and counselling services for establishing child feeding and care practices. It is well documented that the loss in growth in the first 24 months is largely irreversible and preventive measures would be easier to implement through the primary health care system if infancy period is given highest priority. Any delay beyond infancy would be too late for effective prevention of stunting in children (Vir SC and Nigam AK 2001). In India, a shift in programme strategy from under threes to undertwos in the integrated Child Development Services (ICDS) programme, the lead programme for prevention of undernutrition, is important. It needs to be recognised that such a shift in terms of lowering the age cut off by one year reduces the number of families or children to be reached by the system by almost a third and is therefore expected to reduce the overall programme load substantially and contribute to improvement in the ratio of frontline workers and high priority families of under twos with beneficial effect on impact.

The conceptual framework of undernutrition emphasises on addressing the immediate causes of undernutrition by improving child feeding practices and introducing measures prevention of illness. Additionally, the framework emphasises the need to address the underlying causes such as women's care, water sanitation and health services. The statistical analysis of the national and state surveys provide evidence and confirm the significance of the underlying factors such as women's height, BMI, birth outcome and education on nutritional status of children. Recent statistical analysis of raw data of nutrition surveys from Bangladesh and Nepal also report the risk factors for stunting in children (Heady and Hodinott, 2014 and Headey et al., 2014). In Bangladesh, the five risk factors identified were domestic violence, decision making power of women, maternal height, maternal secondary education, wealth quintile. In case of Nepal, the risk factors were maternal height, water, open defecation, institutional birth, ANC visits and maternal education.

The findings provide policy direction for reorganising nutrition interventions with evidence for moving away from a simple solution of providing supplementary food under the ICDS programme. It is evident from the finding that issues pertaining to women's education and anthropometry are important risk factors which need special attention besides appropriate infant and young child feeding and health services. Education of women is not a direct nutrition intervention but a nutrition sensitive intervention which deserves special attention since it has implications on substantially increasing women's status in society and decreasing the pressure on women for early marriage or conception below 18 years, exposure to domestic violence and dependency on others regarding child, family and self-care actions. Besides the focus on care in the first 1000 days, it is evident from risk analysis in India that reaching women prior to onset of pregnancy and ensuring they enter pregnancy well informed and with optimum height and weight is crucial.

These statistical studies, undertaken using the raw data of national and state surveys, provide evidence for introducing changes in the programme direction for accelerating reduction in undernutrition rate in the country. As per the last national survey 2005-6, India has a serious problem of child malnutrition with 42.5 percent underweight and 48 percent stunted children. It is estimated that between 1992-93 and 2005-6, there has been a reduction of less than 10 percentage points in India's stunting rates. The average annual rate of reduction being less than one percent compared to 3.9 percent recommended by WHO (WHO, 2012). The emerging findings of the three statistical analysis reports emphasise the

importance of coupling direct nutrition interventions including improvement on women's nutrition with nutrition sensitive interventions such as women's education and socio-economic improvement for accelerating reduction in prevalence of undernutrition in children in India.

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