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Breast-feeding beyond Infancy and Child Nutritional Status in India and its Regions

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Abstract

The benefits of breast-feeding are well-documented in literature, especially in terms of the growth of the child during the first few months of life. However, a close examination of the literature related to extended breast-feeding suggests that breast-feeding beyond 12 months of age in developing countries is associated with a greater risk for under-nutrition, as defined by lower weight-for-age, height-for-age and weight-for-height. The central hypothesis of this study is to determine the effects of extended breast-feeding on the anthropometric measurements of children in India and its regions using cross-sectional National Family Health Survey-2 data. A simulative approach has been adopted in the paper to find out the effects of extended breast-feeding. Results suggest that extended breast-feeding without supplementary diet was not beneficial for children of all the regions of India. The effect of different extended durations (12-17 months and 18-23 months) of breast-feeding with supplements did not show any significantly different impact on the anthropometric measurements of child health. Further, results suggest that breast-feeding beyond 23 months, along with supplements, has a significantly negative impact on child health. The magnitude of different anthropometric measurements according to different durations of breast-feeding suggests that breast-feeding beyond 23 months is not beneficial.

Keywords

India, under-nutrition, extended breast-feeding, weight-for-age, height-for-age, weight-for-height, anthropometric measurements

1. Introduction

Health and family planning policy-makers in India accept that breast-feeding has numerous advantages, among the most notable, breast-feeding suppresses ovulation during which the chances of conception are virtually nil, and increases child survival. These two important roles of breast-feeding have been well acknowledged in the literature of demography /public health **(**Horta et al. 2007). Recently, Chaparro and Lutter (2007) observed the short and long term effect of breast-feeding on infant and maternal health.

The literature suggests that there are a number of advantages that breast-feeding provides to infants during the first few months of life, such as protecting them from different types of morbidity, maintaining the body temperature and heart rates. Further, the importance of breast-feeding promotion for child nutrition has been well recognized in terms of its affect on morbidity, mortality, and growth during infancy (Jelliffe and Jelliffe 1979; Institute of Medicine 1991). The mechanism through which breast-feeding affects child-nutritional status has been documented (Lawrence 1989; Goldman and Goldblum 1990). Additionally, there may be several differences in the physiological response of infants to breast-milk compared with milk formula, such as lower metabolic rates, slower heart rates, lower body temperature, and decreased nutrient intake (Butte et al. 1984; Garza and Butte 1990).

However, there are other important factors associated with survival, growth and development of the child, such as initiation of breast-feeding, time of weaning, the types and amounts of solid food introduced into the diet, and the presence and severity of infections, particularly febrile infections, respiratory infections and diarrheal infections (Foster 1984; Rowland 1985; Tomkins 1989; Mullany et.al. 2008). Several studies have suggested that breast-feeding alone is insufficient for maintaining growth after six months of age (Whitehead 1983; Institute of Medicine 1991). Others support the concept that the differences in the velocity pattern and body composition associated with the growth of breast-fed infants are natural deviations from formula-fed infants (Dewey et al. 1991). Much of the debate has centered around the effect of prolonged breast-feeding on child nutritional status. The literature shows that extended breast-feeding (beyond 12 months of age) in developing countries is not beneficial for child health. Of 13 studies reviewed by Grummer-Strawn (1993), 11 reported negative associations between prolonged breast-feeding and weight-for-age, height-for-age, or weight-for-height.

Simondon et al. (2001) argued that breast-feeding beyond the first year of life may not be a risk factor for malnutrition. Chaparro and Lutter (2010) observed that maternal and health care characteristics are responsible for increases in the duration of breast-feeding. Lutter *et.al.* (2011), however, reported that improvements in breast-feeding duration over the past 20 years in the Latin American and Caribbean countries were not equitably distributed; rather, they tended to be negative or had the smallest increase in population subgroups whose children are most at risk for mortality and increased morbidity from not being breast-fed.

This paper investigates the role of breast-feeding beyond infancy. The central objective of the paper is to determine the effects of extended breast-feeding on the anthropometric measurements of children during the post-infancy period up to 35 months of age in India and its regions.

2. Methods and materials

The study uses data collected by National Family Health Survey, conducted in 1998-99. The analysis was carried out for India and its six regions: the northern region, which includes Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab and Rajasthan; the central region, which consists of Chhattisgarh, Madhya Pradesh, Uttaranchal and Uttar Pradesh; the eastern region, which comprises Bihar, Jharkhand, Orissa and West Bengal; the northeastern region, which consists of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura; the western region, which includes Goa, Gujarat and Maharashtra; and the southern region, which comprises Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

The six regions follow the classification scheme contained in the NFHS published report (IIPS and ORC Macro 2000). Region-specific analysis was carried out after assigning a proper weight to adjust for the differences in sample size across states. Sample weights were calculated to provide region-wide estimates, for example, for the northeastern region (which contains eight states);

$$1/[8*(n_s/ n_p)]$$

where n_s is the sample size for each state and n_p is the sample size for pooled data. Multiple linear regression analysis was used to determine the impact of extended breast-feeding on child nutritional status. The study included children age 12-35 months.

A strong positive relationship between child and maternal nutritional status has been found in many studies. A simulative approach was adopted in this paper to find out the effects of extended breast-feeding. It was decided to compute the adjusted proportion of undernourished children by breast-feeding status on the assumption that all women in the sample were undernourished. The analysis was also performed on the assumption that all women were well-nourished.

3. Results

3.1 Characteristics of children aged 12-35 months

An attempt was made to study the basic characteristics of children aged 12-35 months for India during 1998-99. The basic characteristics include socio-economic, demographic and health status of the study population, and are presented in Table 1. It is clear from the table that more than one-fourth of the children were in the central region (28.4%), and about one-fifth belong to the eastern region (21.8%). The lowest proportion of children was in the northeastern region (3.5%). For India as a whole, 77 percent of the children were from rural areas.

In India, mothers of about 37 percent of these children were undernourished; 22 percent of the children were small at the time of their birth. With regard to child weight-for-age (WA) and height-for-age (HA), more than 45 percent of the children were malnourished. However, the majority of the children are better nourished in terms of weight-for-height (WH). Nearly one-fifth of the cases were missing for child HA, WA andWH. During two-weeks period prior to the survey, about one-fifth of the children suffered from diarrhea, roughly one-fifth suffered from acute respiratory infections (ARI) and more than 30 percent suffered from either diarrhea or ARI.

Table 1- Socioeconomic, demographic and health status of children aged 12-35 months for India.

Variables	**India**	
	Percent	**Sample size**
Region of residence		
Northern	12.9	4819
Central	28.4	4293
Eastern	21.8	3468
Northeastern	3.5	2822
Western	13.8	2142
Southern	19.5	2823
Place of residence		
Rural	77.1	14919
Urban	22.9	5448
Religion		
Hindu	78.6	14988
Others	21.4	5379
Caste		
SC & ST	29.1	6690
Others	70.9	13677
Mother's education		
Illiterate	58.0	11024
Middle school complete	27.5	6012
High school complete and above	14.5	3331
Standard of living		
Low	37.1	6702
Medium	46.5	9782
High	16.4	3883
Child's age (month)		
12-17	28.5	5682
18-23	22.1	4527
24-35	49.3	10158
Sex of child		
Female	48.5	9722
Male	51.5	10645
Mother's age at birth (yrs)		
< 20	23.5	4191
20-24	39.8	8046
25-29	23.6	5128
>=30	13.1	3002
Birth order		
1	28.6	5901
2	26.2	5321
3	17.9	3588
>=4	27.3	5557
Previous birth interval		
First birth	28.7	5928
<24 months	17.1	3497
24-36 months	26.9	5422
>36 months	27.2	5520

Table 1- cont'd

Variables	India	
	Percent	Sample size
Maternal BMI		
<18.5Kg/m^2	37.2	6813
>=18.5Kg/m^2	53.4	11909
Missing	9.4	1645
Size of child at birth		
Large	14.6	3004
Average	62.4	12496
Small	22.9	4867
Child height-for-age		
Z-score < -2	45.1	8938
Z-score >=-2	35.1	7647
Missing	19.8	3782
Child weight-for-age		
Z-score < -2	46.6	8927
Z-score >=-2	33.6	7658
Missing	19.8	3782
Child weight-for-height		
Z-score < -2	14.5	2750
Z-score >=-2	66.4	13952
Missing	19.1	3665
Recent infection (Diarrhea)		
No	81.7	16503
Yes	18.3	3864
Recent infection (ARI)		
No	81.2	16504
Yes	18.8	3863
Recent infection (Diarrhea or ARI)		
No	68.9	13899
Yes	31.1	6468
Duration of breast-feeding (months)		
<12	12.3	2654
12-17	37.5	7529
18-23	23.2	4695
>=24	27.0	5489
Consumed any type of milk		
No	41.3	8014
Yes	58.7	12353
Consumed any green leafy vegetables/fruits		
No	43.3	8133
Yes	56.7	12234
Consumed any other liquid		
No	48.0	9324
Yes	52.0	11043
Consumed any other solid food		
No	20.8	4064
Yes	79.2	16303
Number of weaning food groups consumed		
0 group	5.7	1053
1-2 groups	42.4	7984
3-4 groups	51.8	11330
Total	**100.0**	**20367**

Note: Percentages are based on weighted data. Numbers are unweighted.

With regard to breast-feeding status, about 12 percent of the children were breast-fed less than 12 months; the majority (37.5%) were breast-fed up to 12 to 17 months. However, more than one-fourth of the children were breast-fed up to 24 months or more. More than half of the children had consumed any type of milk, any green leafy vegetables/fruits or any other drinks and more than three-fourths of them had consumed any other solid food. About half of the children had consumed three to four groups of weaning food (four groups of weaning food include any type of milk, other drinks, any green leafy vegetables/fruits and any other solid/mushy food), and about 6 percent of children consumed none of the weaning foods.

3.2 *Multivariate analysis*

There are number of potential confounders that might alter the results. Therefore, was decided to carry out a multivariate analysis and present the results after controlling all the potential confounders. Table 2 shows the adjusted mean Z score values of different anthropometric measurements of children aged 12-35 months by selected background characteristics for India and its regions during 1998-1999. It is evident from the table that after controlling for all the potential confounders in this analysis, the adjusted mean WA, HA and WH Z scores were highest for the northeastern region and lowest (except in case of WH Z score) for the central region. The regional variations in the mean values of WA, HA and WH Z scores were found significant between almost all the regions, with few exceptions. For instance, the differences in mean WA Z score among the central, the eastern and the western regions were not statistically significant. Further, the difference in HA Z score between the northeastern and the southern regions and the difference in WH Z score between the eastern and the southern regions was also not statistically significant.

The adjusted mean WA and HA Z scores were significantly greater among children of rural areas, whereas the mean WH Z score was poorly associated with the place of residence ($p>0.05$). The mean WA and HA Z scores were found significantly greater for non-Hindu children and also other than SC/ST. The adjusted mean WA, HA and WH Z scores tended to increase with education of women, and this variation among different educational groups was found to be significant. However, the variation in the mean WH Z score between children of illiterate mothers and mothers who completed middle school was not found statistically significant. With regard to standard of living, the adjusted Z scores for different anthropometric measurements were significantly greater with increasing standard of living. The average WA, HA and WH Z scores were significantly lower among children in the age group 18-23 months as compared to other age groups. The mean WA and HA, Z scores for male children were found to be significantly greater than female children while the mean WH Z score was insignificantly higher ($p>0.05$) among female children. There was positive effect-cause relationship between children's anthropometric measurements and their mother's age at birth.

As mother's age at birth increased, the adjusted anthropometric Z scores also increased. The difference in the mean value of WA and HA Z scores was significant among different age groups; the difference in mean WH Z scores among different age groups was not significant. The mean WA, HA and WH Z scores decreased with the increase in birth order; the difference in the mean Z values appeared to be significant in the case of WA and HA. The adjusted mean Z values increased with the increase in the duration of previous birth interval of the index child. However, the variation in mean values according to the duration of previous birth interval was found to be significant in the case of WA and HA Z scores. Children who had an undernourished mother had a significantly lower mean anthropometric Z scores than those children whose mothers were better nourished. With regard to size of child at birth, the average Z values increased significantly as the size of child at birth increased. Children with a recent infection had a significantly lower mean WA and WH Z scores compared with children who did not have a recent infection.

Table 2- Adjusted mean anthropometric measurements of children aged 12-35 months by selected background characteristics for India.

Variables	India		
	Weight-for-age	**Height-for-age**	**Weight-for- height**
Region of residence			
Northern	-2.07[a]	-2.32[a]	-0.85[a]
Central	-2.24[b]	-2.42[b]	-1.01[b]
Eastern	-2.20[b]	-2.21[c]	-1.11[c]
Northeastern	-1.57[c]	-1.86[d]	-0.55[d]
Western	-2.18[b]	-2.03[e]	-1.22[e]
Southern	-2.01[d]	-1.90[d]	-1.10[c]
Place of residence			
Rural	-2.08	-2.20	-0.97
Urban	-2.00[1]	-2.09[1]	-0.94
Religion			
Hindu	-2.08	-2.19	-0.97
Others	-2.02[1]	-2.12[2]	-0.93
Caste			
SC & ST	-2.13	-2.21	-1.01
Others	-2.03[1]	-2.15[2]	-0.93[1]
Mother's education			
Illiterate	-2.19[a]	-2.34[a]	-1.00[a]
Middle school complete	-2.00[b]	-2.07[b]	-0.96[a]
High school complete and above	-1.75[c]	-1.78[c]	-0.85[b]
Standard of living			
Low	-2.23[a]	-2.36[a]	-1.04[a]
Medium	-2.06[b]	-2.17[b]	-0.96[b]
High	-1.76[c]	-1.83[c]	-0.82[c]
Child's age (month)			
12-17	-2.04[a]	-2.04[a]	-0.95[a]
18-23	-2.13[b]	-2.43[b]	-1.07[b]
24-35	-2.04[a]	-2.12[c]	-0.92[a]
Sex of child			
Female	-2.08	-2.21	-0.94
Male	-2.05[3]	-2.13[1]	-0.97
Mother's age at birth (yrs)			
<20	-2.18[a]	-2.34[a]	-0.99*
20-24	-2.06[b]	-2.18[b]	-0.95*
25-29	-2.03[b]	-2.09[c]	-0.97*
>=30	-1.97[c]	-2.05[c]	-0.93*
Birth order			
1	-1.61[a]	-1.49[a]	-0.92*
2	-2.16[b]	-2.34[b]	-0.96*
3	-2.22[c]	-2.43[c]	-0.97*
>=4	-2.33[d]	-2.56[d]	-1.00*
Previous birth interval			
First birth	-2.37[a]‡	-2.67[a]	-0.96*
<24 months	-2.01[a]	-2.09[a]	-0.97*
24-36 months	-1.93[b]‡	-1.98[b]	-0.95*
>36 months	-1.89[c]	-1.86[c]	-0.97*

Table 2- cont'd

Variables	India		
	Weight-for-age	Height-for-age	Weight-for- height
Maternal BMI			
<18.5Kg/m^2	-2.25[a]	-2.26[a]	-1.13[a]
>=18.5Kg/m^2	-1.96[b]	-2.13[b]	-0.85[b]
Missing	-2.05*	-2.09*	-1.01*
Size of child at birth			
Small	-2.30[a]	-2.35[a]	-1.14[a]
Average	-2.02[b]	-2.15[b]	-0.92[b]
Large	-1.84[c]	-1.97[c]	-0.81[c]
Recent infection (Diarrhea or ARI)			
No	-2.03	-2.16	-0.92
Yes	-2.14[1]	-2.19	-1.04[1]
Duration of breast-feeding (months) and supplementary foods (supp)			
<12+no supp	-2.24*	-2.18*	-1.11*
<12+supp	-1.96[a]	-2.08[a]	-0.89[a]
12-17+no supp	-2.21[b]†‡	-2.20[a]‡	-1.07[b]
12-17+supp	-2.01[a]	-2.11[a]	-0.94[a]
18-23+no supp	-2.37[b]	-2.64[b]	-1.03*
18-23+supp	-2.02[a]	-2.12[a]	-0.96*
>=24+no supp	-2.60[b]†	-2.81[b]	-1.15[b]
>=24+supp	-2.16[c]‡	-2.29[c]‡	-1.00[b]

Note: [1]Significantly different from other value, within group, P<=0.01.
[2]Significantly different from other value, within group, P<=0.05.
[3] Significantly different from other value, within group, P<=0.10.
Means without common superscript letters are significantly different, P<=0.05 except few cases then it is denoted by † and ‡.
† Significantly different from other value, P<=0.05.
‡ Significantly not different from other value, P<=0.05.
* That particular value is not significantly different from rest of all other values, within group, P<=0.05 except a case then it is denoted by †.

The adjusted mean anthropometric Z values were significantly lower for children breast-fed for longer time. Further, result revealed that mean anthropometric Z values were significantly greater among those children whose mothers were breast-feeding along with supplementary foods. For instance, children breast-fed with supplements for more than 24 months had a significantly greater adjusted mean WA Z score as compared to children who were breast-fed without supplement any food, for the same amount of time.

The group of children who were breast-fed with supplements for less than 12 months had significantly greater adjusted WA, HA and WH Z scores than those children who were breast-fed for more than 24 months with supplements. Further, the mean WA, HA and WH Z scores were highest among that group of children who were breast-fed for less than 12 months with supplements.

Table 2 shows that there exist regional differences in the magnitude as well as its significance level (at 1, 5 and 10 percent) of adjusted mean values of WA, HA and WH Z scores according to the different background characteristics.

cont'd..Table 2- Adjusted mean anthropometric measurements of children aged 12-35 months by selected background characteristics for different regions of India.

Variables	North			Central			East		
	Weight-for-age	Height-for-age	Weight-for-height	Weight-for-age	Height-for-age	Weight-for- height	Weight-for-age	Height-for-age	Weight-for-height
Duration of breast-feeding (months) and supplementary foods (supp)									
<12+no supp	-3.00[a]	-3.15*	-1.31*	-2.07[a]‡	-2.06[a]‡	-1.04*	-2.08*	-2.17*	-0.95*
<12+supp	-1.87[b]	-2.05[a]	-0.79*	-2.41[a]‡	-2.58[a]‡	-1.09[a]	-2.20[a]	-2.33[a]	-1.02[a]
12-17+no supp	-1.95[b]‡	-2.30*†	-0.66*	-2.66[b]‡	-2.44[a]	-1.50[b]‡	-2.29[a]‡	-2.40[a]	-1.00*
12-17+supp	-1.92[b]	-2.13[a]	-0.81*	-2.30[a]	-2.36[a]s	-1.03[a]	-2.23[a]	-2.29[a]	-1.09*
18-23+no supp	-2.39[a]‡	-2.80[b]‡	-0.84*	-2.40[a]‡	-2.86[a]s†ns	-0.90[a]†	-2.78[b]	-3.13[b]	-1.19*
18-23+supp	-1.92[b]	-2.11[a]	-0.83*	-2.27[a]	-2.42[a]†	-1.02[a]	-2.27[a]	-2.25[a]	-1.20*
>=24+no supp	-2.85[a]	-3.19[b]†	-1.14*	-3.01[b]	-3.22[b]ns	-1.37[a]‡†	-2.60*	-2.64*	-1.33*
>=24+supp	-2.11[c]‡	-2.39[c]‡	-0.86*	-2.55[c]‡	-2.79[b]‡ns	-1.11[a]	-2.47[b]‡	-2.47[a]	-1.25[b]

Note: Adjusted for Place of residence, Religion, Caste, Mother's education, Standard of living, Child's age (month), Sex of child, Mother's age at birth (yrs) , Birth order, Previous birth interval, Maternal BMI, Size of child at birth, Recent infection (Diarrhea or Acute respiratory infections).

[1]Significantly different from other value, within group, P<=0.01.

[2] Significantly different from other value, within group, P<=0.05.

[3] Significantly different from other value, within group, P<=0.10.

Means without common superscript letters are significantly different, P<=0.05 except few cases then it is denoted by †, ‡, s and ns.

† Significantly different from other value, P<=0.05.

s Significantly different from other value, P<=0.05.

‡ Significantly not different from other value, P<=0.05.

ns Significantly not different from other value, P<=0.05.

* That particular value is not significantly different from rest of all other values, within group, P<=0.05.

cont'd..Table 2- Adjusted mean anthropometric measurements of children aged 12-35 months by selected background characteristics for different regions of India.

Variables	Northeast			West			South		
	Wt/A	Ht/A	Wt/Ht	Wt/A	Ht/A	Wt/Ht	Wt/A	Ht/A	Wt/Ht
Duration of breast-feeding (months) and supplementary foods (supp)									
<12+no supp (<=17+no supp)	-0.32*	-0.62*	0.23*	(-2.02*)	(-1.63[a])	(-1.23*)	-2.63*	-2.33*	-1.37*
<12+supp (<=17+supp)	-1.36[a]	-1.64[a]	-0.42*	(-2.01*)	(-1.87*)	(-1.13*)	-1.80[a]	-1.72[a]	-0.96[a]
12-17+no supp (>17+ no supp)	-1.81*	-1.78*	-0.87*	(-2.41*)	(-2.49[b])	(-1.30*)	-2.22[b]‡	-2.09*	-1.14*
12-17+supp (>17+ supp)	-1.59[b]	-1.96[b]	-0.49*	(-2.10*)	(-1.97*)	(-1.18*)	-1.82[a]	-1.68[a]	-1.04*
18-23+no supp	-1.85*	-1.68*	-1.08*	NA	NA	NA	-2.20*	-1.79*	-1.41*
18-23+supp	-1.57*	-1.80*	-0.61*	NA	NA	NA	-1.88[a]‡	-1.79[a]‡	-1.04*
>=24+no supp	-1.98*	-1.94*	-0.94*	NA	NA	NA	-2.31*	-2.71[b]	-0.84*
>=24+supp	-1.54*	-1.80*	-0.56*	NA	NA	NA	-2.06[b]	-1.92[c]‡	-1.15[b]

Note: Adjusted for Place of residence, Religion, Caste, Mother's education, Standard of living, Child's age (month), Sex of child, Mother's age at birth (yrs) , Birth order, Previous birth interval, Maternal BMI, Size of child at birth, Recent infection (Diarrhea or Acute respiratory infections).

[1]Significantly different from other value, within group, P<=0.01.

[2] Significantly different from other value, within group, P<=0.05.

[3] Significantly different from other value, within group, P<=0.10.

Means without common superscript letters are significantly different, P<=0.05 except few cases then it is denoted by † and ‡.

† Significantly different from other value, P<=0.05.

‡ Significantly not different from other value, P<=0.05.

* That particular value is not significantly different from rest of all other values, within group, P<=0.05.

With regard to duration of breast-feeding and status of supplementary foods, result indicates that extended breast-feeding without supplementary food was not found beneficial for children aged 12-35 months in all the region of India. The adjusted WA Z score for children who were breast-fed without any supplementary diets was significantly greater among those groups of children who were breast-fed for 12-17 months than children who were breast-fed for lesser or longer amounts of time as observed for the northern region. Further, the differences in the adjusted WA Z scores among less than 12, 18-23 and more than 23 months of breast-feeding without supplementary diets were not found to be statistically significant. However, children who were breast-fed for more than 23 months with supplementary diets had significantly lower mean WA Z value than those children who were breast-fed for less time with supplementary diets. The differences in adjusted WA Z scores among less than 12, 12-17 and 18-23 months of breast-feeding with supplementary diets were not found statistically significant for the northern region of India. Almost similar observations can be made for the eastern region where children breast-fed without supplementary diets for 12-17 months had significantly greater WA Z score than only that group of children who were breast-fed without supplementary diets for 18-23 months. In the central region, children who were breast-fed for more than 23 months had a lower adjusted mean WA Z score than children who were breast-fed for less time. This finding is irrespective of whether supplements were given with breast-feeding or not. Further, the difference in adjusted mean WA Z score among all other defined categories of duration of breast-feeding was found to be insignificant ($p>0.05$) for this region. The difference in the mean WA Z scores were not found statistically significant for different amounts of time of breast-feeding in case of the western region, irrespective of the fact whether supplementary diets was given or not. However in southern region, children breast-fed with supplementary diets for more than 23 months had a lower adjusted mean WA Z score than that of the children who were breast-fed with supplementary diets for less time.

HA Z scores followed a similar pattern as WA Z scores in most of the regions of India. For instance, children breast-fed with supplements for more than 23 months had significantly lower HA Z score as opposed to shorter duration of breast-feeding with supplements in the northern region. This finding is in line with the earlier finding of WA Z score for northern region. The differences in WH Z scores according to duration of breast-feeding with/without supplementary diets were not found to be statistically significant for most of the regions. However, in the eastern and southern regions the adjusted mean WH Z values were found to be significantly lower among children who were breast-fed for more than 23 months with supplementary dose than children breast-fed for less than 12 months with supplementary diets.

3.3 *Simulation Analysis*

It is important to address the problem of undernourishment of children in India; there is a need to provide policy-makers that are involved in public health management with accurate information on the subject. The predicted probabilities of children aged 12-35 months being underweight, stunted and wasted were calculated for a particular variable (breast-feeding status) by holding all remaining variables constant at their average level along with maternal nutritional status.

Table 3 - Estimated probabilities of children aged 12-35 months being underweight, stunted and wasted by selected combinations of characteristics for India.

Variables	**Probability ± Standard Deviation**		
	India		
	U[1]	**S[2]**	**W[3]**
Average	0.538±0.195	0.539±0.174	0.165±0.085
Duration of breast-feeding (months) & supplementary foods (supp) with Maternal BMI			
<18.5 Kg/m²			
+<12+no supp			
+<12+supp	0.730±0.149	0.577±0.169	0.245±0.101
+12-17+no supp	0.580±0.174	0.534±0.170	0.175±0.080
+12-17+supp	0.645±0.167	0.544±0.170	0.230±0.097
+18-23+no supp	0.583±0.174	0.543±0.170	0.186±0.084
+18-23+supp	0.740±0.146	0.657±0.160	0.200±0.089
+>=24+no supp	0.594±0.173	0.538±0.170	0.194±0.087
+>=24+supp	0.761±0.140	0.681±0.156	0.289±0.112
>=18.5 Kg/m²	0.636±0.168	0.574±0.169	0.219±0.094
+<12+no supp			
+<12+supp	0.640±0.168	0.558±0.169	0.182±0.083
+12-17+no supp	0.476±0.173	0.514±0.170	0.126±0.062
+12-17+supp	0.545±0.175	0.524±0.170	0.170±0.079
+18-23+no supp	0.479±0.173	0.524±0.170	0.135±0.066
+18-23+supp	0.652±0.166	0.638±0.163	0.146±0.070
+>=24+no supp	0.491±0.174	0.519±0.170	0.141±0.068
+>=24+supp	0.676±0.162	0.663±0.159	0.219±0.094
	0.535±0.175	0.555±0.169	0.161±0.076

Note: U, S and W denote Underweight, Stunted and Wasted. [1]Weight-for-age Z score < -2. [2]Height-for-age Z score < -2. [3]Weight-for-height Z score < -2.

Table 3, Figures 1 and 2 present the estimated probabilities of children aged 12-35 months being underweight, stunted and wasted by selected combinations of characteristics for India and its six regions during 1998-99. Table 3 clearly indicates that, at all India level, the probabilities of children being underweight and stunted were comparatively greater than the prevalence of children wasted. However, the prevalence of stunted children was greater in the central, northern and northeastern regions; underweight children were more prevalent in the eastern, southern and western regions.

Figure: 1: Adjusted proportion of children, who had undernourished mother, aged 12-35 months being underweight by duration of breast-feeding in the different regions of India.

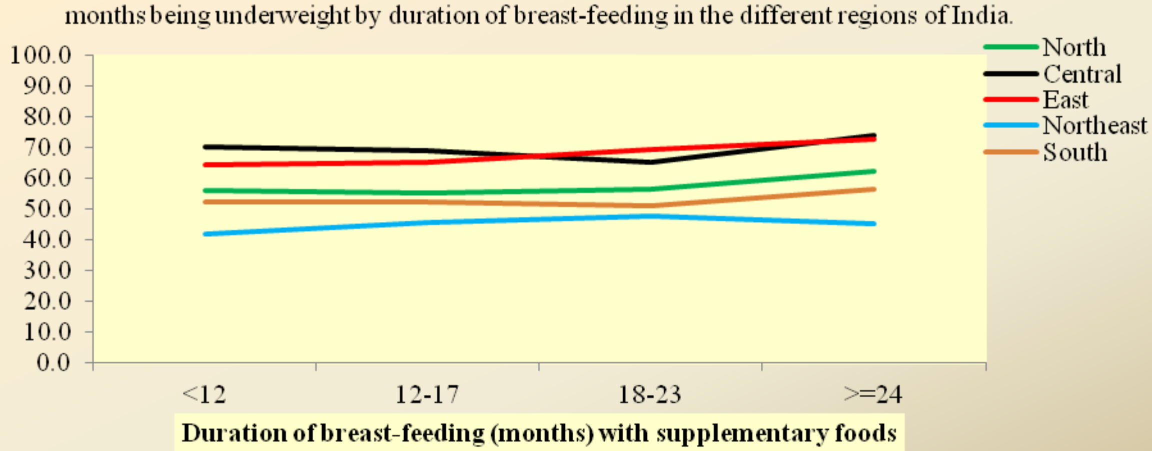
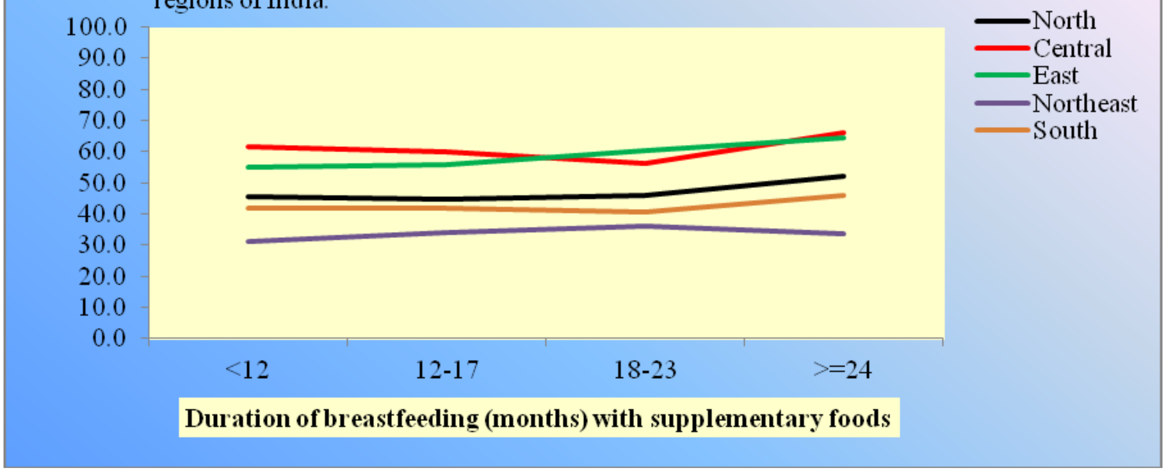


Figure: 2: Adjusted proportion of children, who had well-nourished mother, aged 12-35 months being underweight by duration of breast-feeding in the different regions of India.



When the combined variables of supplementary foods, duration of breast-feeding and maternal nutritional status are taken as one variable, the supplementary diets with breast-feeding do become important for the nutritional status of children. The group of children was breast-fed without supplements had a higher chance of being underweight, stunted and wasted than other groups of children who were breast-fed and were given supplements, irrespective of the duration of breast-feeding and maternal nutritional status. Further, as the duration of breast-feeding without supplementary diets increases, the probability of being undernourished during post infancy period of children also increases. For instance, according to nutritional status of women, undernourished and better-nourished mothers in the central region had the highest percentage of underweight children (around 91 and 87 percent respectively) when children were breast-fed for more than 23 months without any supplementary diets.

Further, the probability of being underweight and stunted declines for the central region, with an increase in the duration of breast-feeding when children were taking some supplementary diets, except in the case of extended breast-feeding (more than 23 months), irrespective of maternal nutritional status. On the other hand, the reverse trend was observed when children were breast-fed without supplements, with the exception of 18-23 months duration of breast-feeding. Moreover, the percentages of underweight, stunted and wasted among those groups of children who were breast-fed for less than 12 months, 12-17 months and 18-23 months with supplementary diets were not found to be different from each other for India and its northern and southern regions, irrespective of maternal nutritional status. However, in the case of the eastern region, the difference between less than 12 and 12-17 months duration of breast-feeding was negligible and afterwards breast-feeding leads to an increase in the percentage of undernourished children. In the western region, when it is assumed that all children were breast-fed for more than 17 months duration of breast-feeding without supplementary diets, the probabilities of being underweight and stunted were highest and these values were also greater than the respective average values, irrespective of maternal nutritional status.

The mean predicted probabilities of children aged 12-35 months being underweight, stunted and wasted were calculated by the duration of breast-feeding and number of weaning food groups consumed by children for India and its regions. The results indicate that the chance of being underweight, stunted and wasted was lower among those children who had consumed any three or more groups of food with extended breast-feeding, for India and its regions.

Further, the results show that at six months of breast-feeding, 35 percent of those children who had not consumed any food were underweight; whereas 46 percent of those children who had consumed three or more groups of food were found underweight for the central region. The results also indicate that at 12 months of breast-feeding; these rates were 77, 66 and 57 percent respectively. These rates have increased to 83, 72 and 59 percent respectively after 24 months of breast-feeding. This result was also true for children being stunted and wasted. The same observation was also made for other parts of India (Table not shown).

4. Discussion and Conclusions

The results of this paper suggest that nutritional status of women and size of child at birth are positively associated with children's anthropometric measurements. These results also suggest that extended breast-feeding without supplementary diet is not beneficial for children of all the regions of India after adjusting the socio-economic, demographic and health status of children. For example, breast-feeding for more than 23 months without supplementary diet had no effect on nutritional status of children. Further, the results also show that exclusively breast-feeding up to six months is important for child growth in India and in the central region.

Extended breast-feeding was linked with different anthropometric measurements of child health, and the results indicate that extended breast-feeding without supplements is not beneficial for children. However, the effect of different extended durations of breast-feeding with supplements, for example, 12-17 and 18-23 months, did not show any significantly different impact on the anthropometric measurements of children health. Breast-feeding beyond 23 months along with supplements has a significantly negative impact on child health. The magnitudes of different anthropometric measurements according to different durations of breast-feeding suggest that breast-feeding beyond 23 months is not beneficial. The results are in line with the earlier findings of Victoria et al. (1984); Brakohiapa et al. (1988) and Ng'andu and Watts (1990). The explanation is that other socio-economic and environmental factors play a stronger role in determining the long term growth. The other possibility may be that breast-feeding suppresses the intake of other foods and was the cause of lower energy intake. Mothers were not completely aware about when and what supplementary food should be introduced and may be ignorant about the importance of other nutritious food required for child growth. However, there is also the possibility that a mother continued breast-feeding because she had an undernourished child. In this situation, low nutritional status is the cause rather than effect of prolonged breast-feeding (Grummer-Strawn 1993). Contrary to this finding, Taren and Chen (1993) found that breast-feeding for more than 18 months was beneficial for children.

If the situation could be that poor nutritional status of child was the cause of prolonged breast-feeding then we would expect that after certain duration of breast-feeding, say after 23 months, the relationship should be in the positive direction. However, it was not the case. It can be argued that by 24 months, maternal breast-feeding decisions are more closely tied to maternal needs rather than child needs.

The analysis at country level was very useful for summarizing the directionality, magnitude and significance of the relationship. The pooled analyses were adjusted for cross- region socio-economic, demographic and biological variations. The “region” effect was significant suggests that there are unmeasured variables that differ among regions and influence child nutritional status. For example, it is more likely that infant feeding behaviours, such as nursing frequency, duration (time spent breast-feeding per day) and intensity varied from woman to woman and region to region.

Urban areas in many developing countries are often associated with better access to health care facilities and other social services. The contact with health care personnel may change the knowledge and behaviour of women in relation to breast-feeding practices. Rural-urban differentials in child nutritional status were pronounced in the northern and eastern regions, except the central, northeastern, western and southern regions of the country. The difference was not found statistically significant because these regions may have the same level of health facilities in both rural and urban areas. For example, the southern region has access to better health care facilities in both rural and urban places; whereas relatively poor health care systems exist in the rural part of central region.

Scheduled castes and scheduled tribes are the lowest and traditionally poorest castes of the Indian caste system. The term-scheduled tribes refer to various aboriginal ethnic minorities who are concentrated in their traditional lands in different parts of India. Therefore, children who belonged to scheduled caste/scheduled tribe community have lower mean value of nutritional measurements as compared to other than these communities in all the parts of India except the northeastern region. In the northeastern region, the socio-economic development of tribal community might have changed the breast-feeding behaviour of women; therefore, children have better nutritional status. Religion had no impact on weight-for-age of child except in the northern and northeast regions. The difference that exists might be due to cultural practices and religious beliefs. For example, breast-feeding has a religious basis in Islam.

The possibility of child being undernourished decreased with the increase of the mother’s age at birth of index child and especially with mother’s education. The relationship between mother’s education and nutritional status of the child is probably due to the fact that more educated women feel greater control over their lives and become more responsible for their child survival. Educated mothers are more likely to identify the aspect of modernization and, thus to seek modern health care (Caldwell and Caldwell 1993). However, the impact of higher education has not appeared significantly in the southern region as compared to other regions of India. The varying impact of educational level on child nutritional status could be due to the change in the composition of educated mothers in the different regions of India.

Further, the findings show that the risk of under-nutrition increased significantly from 12-17 months old children to 18-23 months aged children. There are possibilities that after certain duration of breast-feeding, women just tried to console the children through breast-feeding and actually children were not getting milk. Sex differentials in nutritional status showed that female children were more malnourished than male children in the northern, central and eastern regions; whereas the difference was not found statistically significant in the rest parts of the country. The gender difference in nutritional status is probably the result of biological as well as cultural factors. It is observed that son preference is stronger in the northern and central parts of the country. However, the southern region is characterized by lack of son preference (Arnold et al. 1998).

Poor health of child at birth and also during childhood may lead to less intensity of breast-feeding and further, it may adversely affects the nutritional status of the children. Socio-economic status was a negative confounder of the association between breast-feeding and nutritional status of children. Children from poorer households had lower weight-for-age and were also breast-fed longer than those children from higher socio-economic status households. Instead of prolonged breast-feeding causing malnutrition, it is more likely that economic wellbeing facilitates the choice to stop breast-feeding and also provides the best replacements for breast-milk.

Birth order and length of the birth interval of mothers are important not only for the child's health but also for mother's health. Multiple births close together deplete a woman's body nutrients and increase the risk of giving birth to a low birth weight baby (Williams et al. 1994; Giashuddin et al. 2003). Findings suggest that lengthening the birth interval to more than three years and reducing the number of higher parity births would improve both the health status of the children and the mothers. Data show that duration of breast-feeding increases with the increase in birth order. However, results suggest that higher order births had higher risk of being undernourished. The advantages of breast-feeding were not reflected in higher order of births due to rapid occurrence of pregnancies. Moreover, in rural areas women used to breast-feed longer for last born child because they do not have desire for another one. It is also found that even they are producing less milk but to console the child, they continue breast-feeding.

Results show that undernourished mothers had higher chance to have malnourished child. Further, it is very much consistent across all the six regions of India. The possibility is that undernourished women produce less milk per nursing episode (Delgado et al. 1982) and it would, perhaps, negatively affect the nutritional status of children. However, the intensity of breast-feeding will be very much affected by health status of women. The poor health of mothers may become responsible for their child's health seeking behaviour.

The main limitation of the study is that causal relationship was inferred with the help of cross-sectional data. In some situations a child's health status may affect the feeding practices. For example, some newborns may be too weak to suckle, even though they survive for a longer period. For such children, poor health at birth may lead to never breast-feeding, creating a negative association between breast-feeding and child health. Similarly, for those who do initiate breast-feeding, illness may lead to early weaning and death. Further, there is no information on the timing when supplementary food was introduced.

Further, data on frequency of breast-feeding and the time at introduction of supplementary food were not available. The current data set did not include the many intra-household factors that have been related to a child growth, such as the amount of food consumed, the frequency of breast-feeding sessions, the amount of breast-milk consumed at various ages throughout the second year of life, and parental anthropometric measurements. The cross-sectional design also did not allow for longitudinal growth data, to determine its association with changes in the total dietary pattern of the children. It is also not possible to control for all covariates through multivariate analyses and there could have been other factors that were more strongly associated with growth or confounded with breast-feeding (Caulfield et al. 1996).

These limitations support the need for more research on the association between breast-feeding during the second year and the growth of children in developing countries. Future, research should also include designs that allow studies on the immunological benefits of extended breast-feeding and how maternal health is affected by extended breast-feeding.

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