Original Article

Undernutrition among infants less than 6 months of age: an underestimated public health problem in India

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Abstract

In India most childhood nutrition recommendations and interventions are still not focused on infants under 6 months. Secondary data analyses of National Family Health Survey-3 data from India were analysed to compare the prevalence of wasting, stunting and underweight in infants less than 6 months and 6–59 months. Our results revealed that wasting was higher (31%) in infants less than 6 months ($P < 0.05$) as compared with children between 6 and 59 months. Thirteen per cent of infants less than 6 months had severe wasting, 30% were underweight and 20% were stunted. Most infants (69%) were exclusively breastfed (EB) for the first 2 months, but exclusive breastfeeding dropped to 50% at 2–3 months and to 27% at 4–5 months. There was no statistically significant difference in wasting and stunting in the EB and not exclusively breastfed (NEB) groups. Significantly fewer EB infants were underweight (28%) compared with NEB infants (31%) ($P = 0.030$). However, among EB children, 29% had wasting and 21% were stunted. Eleven per cent of EB infants were severely underweight, 13% were severely wasted and 9% were severely stunted. Diarrhoea was significantly lower among EB infants compared with NEB infants ($P < 0.05$). We conclude that infants less than 6 months of age are vulnerable to suffer from acute severe malnutrition irrespective of their breastfeeding status and need to be seriously considered for inclusion in national guidelines for early detection and management of undernutrition.

Keywords: breastfeeding, child nutrition, stunting, undernutrition, underweight, wasting.

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Introduction

Child undernutrition due to stunting, severe wasting and intrauterine growth restriction is reported to be responsible for 2.2 million deaths and 21% of disability-adjusted life-years for children younger than 5 years (Black *et al.* 2008). Early detection and appropriate management of undernutrition is included in child survival strategies like the Integrated Management of Childhood Illness (IMCI) that

specially focus on the detection and management of undernutrition in sick children younger than 5 years who report to a health facility. Special interventions have also been introduced to identify and manage children with severe acute malnutrition (SAM) in order to combat death and disability as a consequence of undernutrition. World Health Organization (WHO) guidelines are widely used for the identification of 6–60-month-old infants and children for the management of children with SAM (WHO 2009).

The Multicountry Growth Reference Study (MGRS) has developed growth standards from 0 to 60 months that are intended to help monitor the growth of every child worldwide regardless of ethnicity, socio-economic status and type of feeding (de Onis 2011). However, these references are not utilised by some countries, including India, in formulating management guidelines for infants younger than 6 months. This age group, considered extremely vulnerable to undernutrition (Kerac *et al.* 2009), is now expected to be included in the WHO revised guidelines on SAM children (WHO 2012).

Infants less than 6 months are often excluded from nutrition surveys and marginalised in nutrition programmes (Kerac *et al.* 2011). The first 6 months of life are characterised not only by maximum growth velocity but also by vulnerability to nutrition-related events and insults. A WHO/UNICEF joint statement (WHO 2009) recommended a transition to WHO growth standards to identify wasting but only reviewed the implications for children aged 6–60 months. The expected addition of infants under 6 months in future WHO guidelines for SAM children (WHO 2012) will respond to the needs of this vulnerable age group.

This article looks at the burden of undernutrition in infants in India younger than 6 months based on secondary data analyses of the National Family Health Survey (NFHS)-3 (Mari Bhat *et al.* 2007). The objective is to present evidence demonstrating the burden of SAM in infants under 6 months. In doing so, we aim to convince and stimulate clinicians, nutritionists, public health professionals and policy makers in India to adopt the revised WHO nutrition standards

quickly, and give high priority to detecting and managing undernutrition in infants under 6 months.

Material and methods

The worldwide known Demographic and Health Surveys (DHS), known as the NFHS in India, has provided accurate and representative data on population, health, HIV and nutrition through more than 300 surveys in over 90 countries. In India, three rounds of this nationally representative survey, with comparable results over time, have been conducted. The NFHS-1 was conducted in 1992–1993, the NFHS-2 in 1998–1999 and the NFHS-3 in 2005–2006. The household response rate in the NFHS-3 was recorded as 97.7%, which is fairly high, and the likelihood of adverse effect on the results due to no-response is minimal.

In this paper, secondary analyses of NFHS-3 individual data records were performed after obtaining the data sets from the Measure DHS web site (<http://www.measuredhs.com>). Deeper analysis of records of children younger than 5 years of age with special focus on infants under 6 months was conducted. We assessed the burden of underweight, wasting and stunting, estimated the prevalence of exclusive breastfeeding for 6 months, and tested associations between exclusive breastfeeding, nutritional status and common childhood illnesses like acute respiratory infection, diarrhoea and fever.

The NFHS-3 collected information from a nationally representative sample of 109 041 households, representing 99% of India's population living in 29 states. Although the survey investigated reproductive and

Key messages

- In India, a higher percentage of infants less than 6 months of age are wasted as compared with the older age group. National Family Health Survey-3 data reveal severe wasting in more than 13% of infants less than 6 months of age.
- More than one-fifth of exclusively breastfed (EB) infants were underweight, wasted and stunted.
- Infants less than 6 months, including those who are EB, are vulnerable to episodes of common childhood illnesses known to influence nutritional intake and risk of undernutrition.
- Infants aged under 6 months are often excluded from nutrition surveys and marginalised in malnutrition treatment programmes.
- The World Health Organization (WHO) and UNICEF recommended a transition to WHO growth standards to identify wasting but only reviewed the implications for children aged from 6 to under 60 months.

Table 1. WAZ,WHZ and HAZ of Indian children 0–59 months – National Family Health Survey-3, 2005–2006

Age in months	WAZ*		WHZ*		HAZ*	
	Underweight	Severe underweight	Wasting	Severe wasting	Stunting	Severe stunting
	<–2 SD to –3 SD	<–3 SD	<–2 SD to –3 SD	<–3 SD	<–2 SD to –3 SD	<–3 SD
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
<6 (<i>n</i> = 3 807)	711 (18.7)	416 (10.9)	665 (17.5)	501 (13.1)	450 (11.8)	328 (8.6)
6–59 (<i>n</i> = 41 569)	11 473 (27.6)	6 843 (16.5)	5 483 (13.2)	2 450 (5.9)	10 603 (25.5)	10 532 (25.3)
Total (<i>n</i> = 45 376)	12 184 (26.8)	7259 (16.0)	6 148 (13.5)	2 951 (6.5)	11 053 (24.4)	10 860 (23.9)
Chi-square values	297.7 (<i>P</i> = 0.000)		288.046 (<i>P</i> = 0.000)		1 299.2 (<i>P</i> = 0.000)	

WAZ, weight for age; WHZ, weight for height; HAZ, height for age. *Significant at *P* < 0.05.

child health challenges, it also measured nutritional status among children. The information based on the NFHS series has been well recognised in India by academia, government, and non-governmental organisations and has been used as one of the most authentic estimates in the country. The survey measures height and weight for all children listed in the household questionnaire born 5 years preceding the survey. Every interviewing team included two health investigators who conducted anthropometric measurements using a scale and measuring board. The solar-powered electronic SECA scale with a digital screen was designed and manufactured under the guidance of UNICEF. The measuring board was specially designed for use in survey settings. Children younger than 24 months were measured lying down on the board (recumbent length); older children were measured while standing (Mari Bhat *et al.* 2007).

The standard indices of physical growth that describe the nutritional status of children in the NFHS-3 report are weight for age (WAZ; underweight), weight for height (WHZ; wasting) and height for age (HAZ; stunting). Indicators are expressed as Z scores in standard deviation (SD) from the median of the reference population. The WHO Multicenter Growth Reference Study Group growth standards were used as reference (Mari Bhat *et al.* 2007). Extreme values of the Z scores, attributed to errors in height and weight data, are considered unacceptable. Therefore, the raw data file assigned a flag to these cases. In the analysis all these flagged cases were removed while computing the indices.

Information on breastfeeding was obtained from a series of questions in the Women's Questionnaire.

The variables included ever breastfed, currently breastfeeding and type of liquid or food given to the youngest child during the day or at night 1 day prior to survey. Children who received nothing but breast milk during the previous day or night were classified as being exclusively breastfed (EB).

Prevalence of acute respiratory infection, diarrhoea and fever was calculated based on mothers' perception of illness without validation by medical personnel. A 2-week recall period was considered suitable for ensuring an adequate number of cases to analyse with minimal recall errors (Mari Bhat *et al.* 2007).

The individual-level data files of the NFHS were obtained from Macro International, the technical agency supporting the NFHS in India (Measure DHS 2005–2006). The raw data pertaining to all the surveyed children under 5 years were analysed using spss (Version 18, IBM Corporation, Armonk, NY, USA). Appropriate weights available in the data files were used to derive weighted estimates of all the variables in the present paper. Univariate and cross-tabulation of the relevant indicators were generated to interpret the results. Chi-square test was employed to establish associations between variables and levels of statistical significance.

Results

Z-scores for 45 376 children under the age of 5 were analysed and compared with median WHO growth standards to assess underweight (WAZ), wasting (WHZ) and stunting (HAZ) (Table 1). One-third of infants (30.6%) less than 6 months were wasted, a proportion significantly higher than children 6–60

Table 2. Breastfeeding by age in India National Family Health Survey-3, 2005–2006

Age in months	Total	Exclusively breastfed	Not exclusively breastfed	Not breastfed
		No. (%)	No. (%)	No. (%)
<2	1 276	881 (69.0)	364 (28.5)	31 (2.4)
2–3	1 875	939 (50.1)	911 (48.6)	25 (1.3)
4–5	1 981	542 (27.4)	1 406 (71.0)	33 (1.7)
6–8	2 919	280 (9.6)	2 527 (86.6)	112 (3.8)
9–11	2 342	65 (2.8)	2 130 (90.9)	147 (6.3)
12–17	5 187	74 (1.4)	4 485 (86.5)	628 (12.1)
18–23	5 154	159 (3.1)	3 873 (75.1)	1122 (21.8)
24–35	10 232	593 (5.8)	6 042 (59.1)	3597 (35.2)
0–36	30 966	3533 (11.4)	21 738 (70.2)	5695 (18.4)

months of age ($P < 0.05$). Severe wasting was detected in 13.1% of infants less than 6 months of age. In comparison with infants less than 6 months, a higher percentage of children aged 6–59 months were underweight ($P < 0.05$) and stunted ($P < 0.05$), but 29.6% of infants less than 6 months were underweight and 20.4% were stunted.

Data from 41 081 children aged 0–59 months were available for analysis of breastfeeding practices (Table 2). Most infants (69%) were EB for the first 2 months of age. Exclusive breastfeeding dropped to 50% at 2–3 months of age and to 27% at 4–5 months. Overall, slightly less than half of the children under 6 months of age were EB.

In order to assess the relationship between exclusive breastfeeding, underweight, wasting and stunting, data from 3806 infants under 6 months were analysed. There was no statistically significant difference in wasting and stunting in the EB and not exclusively breastfed (NEB) groups. Significantly fewer infants who had been EB were underweight (27.8%) compared with those NEB (31%) ($P = 0.030$). However, among EB children, 29.3% had wasting and 21.2% were stunted. 10.7% of EB infants were severely underweight, 12.7% were severely wasted and 8.6% were severely stunted (Table 3).

Feeding practices of children under 6 months were correlated with common childhood illnesses 2 weeks prior to the survey using data on acute respiratory infections ($n = 4552$), diarrhoea ($n = 5130$) and fever

($n = 5130$). Diarrhoea was significantly lower among EB children compared with NEB children ($P < 0.05$; Table 4).

Discussion

In India, management of severe undernutrition in children aged 6 months and over is a high priority; therefore, most childhood nutrition recommendations and interventions are focused on this group. While the burden of undernutrition of infants under 6 months is beginning to gain attention internationally, it is not yet a focus in India (Sachdev *et al.* 2010). One of the major reasons infants younger than 6 months have been excluded from nutritional surveys is that anthropometric measurement presents practical and technical difficulties. Weight is easy to measure in older infants and children, but in younger infants baby-weighing scales accurate to 10 g need to be used instead of the Salter or bathroom scales (M/s Salter India Limited, Haryana, India) generally used. Measuring length in infants under 6 months is also more difficult because survey personnel may not be used to measuring very young infants and fear hurting them (Lopriore *et al.* 2007). Some of the reasons for not including young infants below 6 months of age while developing the guidelines for severe malnutrition are attributed to the rapid and changing rate of growth in young infants, different nutrient requirements, and less mature physiological processes than those of older infants. This age group is also more heterogeneous in terms of underlying aetiology and pathophysiology than older infants.

One of the reasons for not including infants under 6 months in nutrition surveys could be attributed to programmatic challenges in the implementation of the interventions. Increased survey prevalence equates to greater numbers eligible for treatment, leading to additional burden on the already overburdened health services. Another potentially harmful consequence of an infant being diagnosed as 'small' (i.e. below 3 or 2 WHZ) is that mothers of clinically well, EB infants might become concerned (Sachs *et al.* 2006; Laraway *et al.* 2010) and unnecessarily introduce 'top-up' foods or breast milk substitutes (Binns

Table 3. WAZ,WHZ and HAZ by breastfeeding status under 6 months of age in India – National Family Health Survey-3, 2005–2006

Breastfeeding status	WAZ		WHZ		HAZ	
	Severe underweight	Underweight*	Severe wasting	Wasting*	Severe stunting	Stunting*
	<–3 SD	<–2 SD	<–3 SD	<–2 SD	<–3 SD	<–2 SD
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Exclusively breastfed (<i>n</i> = 1675)	179 (10.7)	466 (27.8)	213 (12.7)	491 (29.3)	144 (8.6)	355 (21.2)
Not exclusively breastfed (<i>n</i> = 2131)	237 (11.1)	662 (31.1)	288 (13.5)	675 (31.7)	184 (8.6)	423 (19.8)
Total (<i>n</i> = 3806)	416 (10.9)	1128 (29.6)	501 (13.1)	1166 (30.6)	328 (8.6)	778 (20.4)
Chi-square values**	–	4.734 (<i>P</i> = 0.030)	–	2.462 (<i>P</i> = 0.117)	–	1.042 (<i>P</i> = 0.307)

SD, standard deviation; WAZ, weight for age; WHZ, weight for height; HAZ, height for age. *Includes children who are below –3 SDs from the International Reference Population median. **Significant at *P* < 0.05.

& Lee 2006). In other words, there is a fear that identifying children as small or undernourished would have adverse effects on exclusive breastfeeding.

Infants under 6 months face multiple risks for developing a nutritional deficiency, including delay in initiating breastfeeding, not sustaining exclusive breastfeeding until 6 months, early introduction of complementary feeding, and inadequate feeding due to repeated episodes of diarrhoea, acute respiratory infections, and other illnesses. The results of our secondary data analysis dispel the notion that wasting is not a common clinical presentation in infants less than 6 months of age. A significantly higher proportion of infants under 6 months were found to be severely wasted in NFHS-3 data compared with those aged 6–59 months. Prevalence of wasting is reported to be greater while using WHO growth standards to define the cases than when using National Center for Health Statistics (NCHS) references, and data from several studies show that a large number of infants under 6 months in developing countries are wasted (de Onis *et al.* 2006; Kerac *et al.* 2011).

The WHO guidelines for diagnosing and treating severe malnutrition that are being revised now are expected to include infants under 6 months, and these new guidelines are likely to be adopted in India over the next couple of years. This change at the policy level will be of critical importance, but it will not alleviate the difficulties associated with diagnosing and managing severe malnutrition in this age group.

These challenges include rapid and changing rate of growth in young infants and more heterogeneity in terms of underlying aetiology and pathophysiology than older infants. The common assumption that breastfeeding protects against early malnutrition until approximately 6 months of age (Martorell & Habicht 1996) has also influenced the attention this age group deserves. But analysis of growth-faltering patterns using the new WHO growth standards suggests that weight for length/height starts slightly above the standard in children aged 1–2 months and falters slightly until 9 months of age (Victora *et al.* 2010).

Breastfeeding is a cultural norm in India, particularly in rural areas, but exclusive breastfeeding rates are low at all times during the first 6 months of life and as low as 18.6% between 4 and 6 months. Therefore, a majority of infants, particularly those between 4 and 6 months of age, are NEB at a time when they are more vulnerable to infection and poor nutritional intake. Even for those who were EB, protection against nutritional deficiency is not absolute. NFHS-3 data reveal that 27.8% of EB infants under 6 months were underweight, 29.3% were wasted and 21.2% were stunted. Severe wasting was recorded in 12.7% of EB infants.

Repeated infections and reduced feeding during illness are common causes of worsening nutritional status in children. Our data indicate that EB infants did have significantly fewer diarrhoeal episodes than

Table 4. Feeding practices among children <6 months and symptoms of ARI, diarrhoea and fever, India, National Family Health Survey-3, 2005–2006

Feeding status	Symptoms of acute respiratory infections				Diarrhoea [†]				Fever [*]			
	Total observations		Yes		Total observations		Yes		Total observations		Yes	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Exclusively breastfed	2096		149 (7.1)	1947 (92.9)	2362		203 (8.6)	2159 (91.4)	2362		259 (11.0)	2103 (89.0)
Not exclusively breastfed	2456		168 (6.8)	2287 (93.1)	2768		343 (12.4)	2425 (87.6)	2768		339 (12.2)	2429 (87.7)
Total	4552		317 (7.0)	4234 (93.0)	5130		546 (10.6)	4584 (89.4)	5130		598 (11.7)	4532 (88.3)
Chi-square value	0.977 ($P = 0.614$)											
	19.3 ($P = 0.000$)											
	2.240 ($P = 0.326$)											

*Symptoms during last 2 weeks prior to survey. [†]Significant at $P < 0.05$.

NEB infants. But the protection is not universal as 9% of EB mothers reported an episode of diarrhoea 2 weeks before the survey. No significant correlation was seen between exclusive breastfeeding and acute respiratory infection and fever. Our observation does suggest that infants less than 6 months, including those who are EB, are vulnerable to episodes of common childhood illnesses known to influence nutritional intake and risk of undernutrition.

The problem of undernutrition in infants younger than 6 months, irrespective of their breastfeeding status, is glaring and anthropometric measurements are not suitable for use in this age group because of lack of sensitive weighing scales and trained personnel to take the measurements. But technical difficulties in measuring length and procuring sensitive weighing scales cannot undermine the fact that, like their older counterparts, infants less than 6 months of age stand a high risk of nutritional deficiency and particularly wasting. WHO growth standards based on the MGRS provide a better guideline in monitoring the rapid and changing rate of growth in early infancy than the NCHS (de Onis *et al.* 2006). The MGRS has developed six incremental stand-alone tables describing growth standards in months 1–6, which clinicians should use to most closely approximate the interval over which the child is seen (WHO Multicentre Growth Reference Study Group 2006). However, there is also a need for alternative diagnostic criteria alongside anthropometry like different Z scores, mid-upper arm circumference, body mass index and clinical criteria (as in IMCI guidelines). Apart from uses of growth curves, development of ‘growth velocity standards’ would provide a set of unique tools for monitoring the rapid and changing rate of growth in early childhood and thus the early identification of children at risk of becoming under- or overweight (de Onis 2011). These could be useful in the 0–5 months age group.

One of the limitations of our analysis is that the birthweight of the infants subjected to secondary data analysis was not known for many of the children in the data sets, and therefore, the influence of low birthweight on the detection of wasting cannot be assessed. The other limitation is that the NFHS-3 was not designed to look specifically for factors associated

with malnutrition in infants under 6 months; rather, it provided estimates of malnutrition among children and makes no attempt to determine causal factors after controlling for confounders. Breastfeeding analysis is not age adjusted in this study. Hence, both undernutrition and exclusive breastfeeding peak at 4–6 months. Therefore, age is an important confounder if all infants 0–6 months are grouped together.

There are practical difficulties in taking anthropometric measurements of young infants and developing age-appropriate treatment guidelines within the broad age group of 0–6 months. But the burden of undernutrition in infants less than 6 months cannot be ignored. There is a need to focus on the training of personnel using more accurate scales for early detection of undernutrition and using alternative diagnostic criteria. It is reassuring to note that many countries do have guidelines already in place for this age group (Kerac *et al.* 2009), and forthcoming WHO guidelines for children with SAM will also include infants less than 6 months of age. This should pave the way for modifying management guidelines for severe malnutrition in India. Future research is required to develop age-appropriate guidelines for the treatment of moderate and severe malnutrition in this vulnerable age group.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

AKP conceived the study, interpreted the data and wrote the initial draft of the manuscript. SK analysed and interpreted the data and contributed to the initial draft of the manuscript. JB contributed to the initial draft and edited the manuscript. All co-authors par-

ticipated in manuscript preparation and critically reviewed all sections of the text for important intellectual content.

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