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A Reassessment

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Introduction

Preventing under-nutrition in children has emerged as one of the most critical challenges to India's development. Under-nutrition erodes human capital, reduces resilience to shocks and reduces productivity because of impaired physical and mental capacity. Under-nutrition is directly or indirectly related to more than 50 per cent of all child mortality and is the main contributor to the burden of disease in children. Among women, under-nutrition is associated with most major risk factors of maternal mortality. Weakening of the body resistence as the result of under-nutrition contributes significantly to increased prevalence of diseases like tuberculosis, malaria and other diseases and reduces the survival rates. Under-nourished children have also been found to be having higher risk of developing hypertension and diabetes.

Interventions directed towards addressing under-nutrition in children in India are organised under the Integrated Child Development Scheme (ICDS) which is the world's largest programme focused on the growth and development of children. Launched way back in 1975, the Scheme aims at breaking the vicious cycle of under-nutrition, morbidity, reduced learning capacity and mortality in children (Government of India, 1975). One of the objectives of the Scheme is to improve the nutritional and health status of children 0-6 years of age. The interventions directed towards improving the nutritional status of children include supplementary nutrition, prophylaxis against vitamin A, control of nutritional anaemia and growth monitoring. The supplementary nutrition attempts to bridge the calorie gap between the nationally recommended and the average intake of the child whereas growth monitoring is based on the weight of the child which is recorded on the weight-for-age chart designed for the purpose.

The current evidence, however, suggests that child under-nutrition continues to be a silent emergency in India's quest towards social and economic progress. Estimates based on the information available through the National Family Health Survey 2005-06 suggest that, around 2006, almost 40 million children below 5 years of age in India were low weight-for-age; more than 55 million were low height-for-age; and around 23 million children were low weight-for-height. The enormity of the problem of under- nutrition among children in India is obvious.

This paper has three objectives. The first is to highlight the limitations of the official approach to address under-nutrition in children in terms of capturing different

dimensions of child nutrition. The second objective of the paper is to re-assess the situation of under-nutrition in India in the context of the recommendations put forward by the World Health Organisation. These recommendations suggest that under-nutrition in children is essentially a two-dimensional process and, therefore, a two-dimensional approach should be adopted for measuring and monitoring under nutrition in children. Following these recommendations, the paper uses data on height and weight of children below five years of age available through the National Family Health Survey 2005-06 to make new assessment of the nutritional status of children in India and its constituent states. Finally, the paper outlines a framework for addressing the two dimensions of under-nutrition.

Measurement of Child Nutrition

The measurement of the nutritional status of children is generally based on the relationship between the nutritional status and the growth and development of the child. The standard approach of assessing the nutritional status of the child in this framework is to compare the body build of a child with the body build of other healthy (reference) children. If the body build of the child is poorer than the body build of the reference population, the child is classified as under-nourished and vice versa. The key issue in this approach is to measure the body build of the child, the best measure of which, perhaps, is the weight per unit volume of the body (Chaurasia and Pattankar 1979). The major problem in using the weight per unit volume criterion is the measurement of the volume of the body. The gold standard is the water replaced by the body while floating but this method is too subjective to be used in large scale surveys and in field trials. Chaurasia and Pattankar (1979) have developed a method for measuring the volume of the body on the basis of the length/height and chest circumference of the child and have developed an index for measuring the body build in absolute terms.

Different physical (anthropometric) measurements of the child can be used either independently or in combination to assess the growth and hence the nutritional status of the child. As child grows, its body develops in all the three dimensions and not in just one dimension. This means that a multidimensional approach should be adopted for measuring the nutritional status of children. There are many physical measurements of the child that can be used for the purpose. These include weight, length or height, chest circumference, mid upper arm circumference and head circumference (Govila, Chaurasia, Dev 1980; WHO 1995). Among these, weight and height are the most commonly used. Gomez and others were the first to develop a classification for measuring the growth and nutritional status of children on the basis of the body weight (Gomez et al 1956) which was later modified by Jelliffe (1966). The Indian Academy of Pediatrics has also developed a similar classification (IAP 1972) which constituted the basis for the child growth monitoring system established under the Integrated Child Development Scheme in India. The

World Health Organisation, on the other hand, recommends a two dimensional approach for assessing the nutritional status of children (Waterlow et al 1977, WHO 1995). Under the Integrated Child Development Scheme of the Government of India, however, the nutritional status of children is assessed on the basis of only weight of the child.

Once the body build of the child is approximated by an index of the body build - whether weight or height or a combination of the two or any other index - the standard approach to assess the growth and nutritional status of a child is to compare the index of the child with the index of healthy (reference) children. This comparison is carried out separately for different ages as well as separately for boys and girls. If the index of the body build of the child of a given age and sex is poorer than the index of the body build of reference children of that age and sex, the child is classified as under-nourished. This comparison can be done in two ways. The first is the 'proportion of median' approach in which a child's index of body build is expressed as proportion of the median value of the reference population. If this proportion is less than the pre-specified cut off point, the child is classified as under-nourished. This method, however, does not take into consideration, the variation in the index of the body build of children that constitute the reference population. It is naive to presume that all children in the reference population have the same index of the body build.

The second approach, recommended by the World Health Organisation, expresses the index of the body build in terms of the number of standard deviation units that a child's index deviates from the median value of the reference population. These standard deviation units are called z-scores (WHO 1995). Statistically, z-score is very similar to the standard normal variate with mean replaced by median to exclude extreme values. Cut-off points have been fixed to assess whether a child is under-nourished or not on the basis of the z-score. If the z-score of a given child is less than -2, the child is classified as under-nourished. The approach suggested by the World Health Organisation has distinct advantages over the approach of assessing the nutritional status of children on the basis of the proportion of the reference mean or median (Sachdev 1994). First, estimation of the z-score takes into consideration, the variation in the body build in the reference population (WHO 1986; Waterlow et al 1977; Dibley et al 1987). Second, the cut off points based on the proportion of the reference mean or median differ by age and gender (Nigam 2003). As such, assessing the nutritional status of children of different ages by the same cut off points becomes erratic.

The approach recommended by the World Health Organisation has now been adopted universally to measure and monitor child under-nutrition. Under the Integrated Child Development Scheme in India, however, classification of children as nourished and under-nourished continues to be based on the IAP classification. It has, however, been observed that the proportion of median cut-off points under the

IAP classification does not capture a substantial number of children identified as under-nourished through the z-score classification (Nigam 2005).

Another important issue in the assessment of the nutritional status of children is related to the anthropometric measurement to be used for the purpose of classification. The most commonly used measurements are weight, height and weight-for-height. Unfortunately, nutritional assessment based on the three measurements depict three different pictures. Weight is most commonly used for the assessment of nutritional status of children. Height and weight-for-height, on the other hand, reflect two distinct biological processes which influence the nutritional status of the child. Height and weight-for-height reflect two dimensions of child growth and nutrition. Height reflects the skeletal growth of the child while weight-for-height reflects the body mass in relation to height. Finally weight reflects both the skeletal growth and the body mass in relation to height. If a child is classified as under-nourished on the basis of the weight, then it is not clear whether the under-nutrition is due to poor skeletal growth (stunting) or due to low body mass in relation to height (wasting) or both. The World Health Organisation recommends that height and weight-for-height should be used in combination to assess the nutritional status of children (WHO 1955). It has also been observed that assessment of nutritional status based on weight, height and weight-for-height overlap and none gives a comprehensive picture of child under-nourished in a population. Therefore, none of the three indexes are sufficient to measure the overall prevalence of under-nourished children (Svedberg 2001). Svedberg has suggested a comprehensive index of anthropometric failure (CIAF) to estimate the proportion of under-nourished children in the community. The index proposed by Svedberg has also been used by Nandy and colleagues (2005) and by Gaiha, Jha and Kulkarni (2010) to assess the magnitude of the problem of child under-nutrition in India. These analyses reveal that using weight as an index of under-nutrition, as is currently being done under the Integrated Child Development Scheme in India, substantially underestimates the true prevalence of child under-nutrition in the country. Seetharaman and others, on the basis of a study in an urban slum in a south Indian city, have concluded that identifying under-nutrition on the basis of weight alone underestimates the true prevalence of child under-nutrition by as much as 22 per cent (Seetharaman et al 2007). Obviously, a multidimensional approach as suggested by the World Health Organisation needs to be adopted to assess the nutritional status of children.

Svedberg's model of constructing CIAF identifies seven groups - children with height and weight appropriate for their age and children with either height or weight or weight-for-height either singly or in combination not appropriate for their age and are thus classified as under-nourished. This second group comprises of six combinations of height, weight and weight-for-height. Gaiha, Jha and Kulkarni, on the other hand, have used nine combinations of height, weight and weight-for-height

as they observed that there were children having weight not appropriate for their age despite the fact that their height and weight for height were found to be appropriate for the age.

It may pointed out that weight of a child can be expressed as the product of the height and weight per unit height. If W_a denotes the weight of the child of age a and H_a its height, then

$$W_a = H_a*(W_a/H_a) = H_a*T_a \quad (1)$$

Let W_{ar} and H_{ar} denote the weight and height respectively of the reference population, then we also have

$$W_{ar} = H_{ar}*(W_{ar}/H_{ar}) = H_{ar}*W_{ar} \quad (2)$$

Now

$$W_a-W_{ar} = (H_a*T_a)-(H_{ar}*T_{ar}) \quad (3)$$

which can be decomposed as

$$W_a-W_{ar} = (H_a-H_{ar})*T_{ar})+ (T_a-T_{ar})*H_{ar}+(H_a-H_{ar})*(T_a-T_{ar}) \quad (4)$$

Equation (4) suggests that a child can be under-weight only when it is either stunted or wasted or both. In other words, if the child is neither stunted nor wasted, the child cannot be classified as under-weight. However, Nandy and others and Gaiha, Jha and Kulkarni have observed that there were some children in India who were under-weight despite the fact that they were neither stunted nor wasted. This observation is in contradiction to the theoretical relationship described by equation (4). The reason lies in the standards used for assessing the nutritional status. The standards for weight and height are age specific while standards for weight-for-height are age independent. In order to explore why a child may be under-weight without being stunted or wasted, we have calculated the weight per unit height on the basis of standards for weight and height which are age specific and standards for weight-for-height which are age independent. For a given age a, the weight per unit height in the reference population is given by $u_{ar} = (W_{ar}/H_{ar})$. Given the height H_{ar}, the corresponding weight (W_{as}) may also be obtained from the weight-for-height standard and in this case the weight per unit height is $v_{ar} = (W_{as}/H_{ar})$. Ideally, $u_{ar} = v_{ar}$. It has however been found that $u_{ar}>v_{ar}$ and the difference increases with age. This means that a child classified as under-weight on the basis of weight alone may be classified as not wasted on the basis of weight-for-height even if the child is not stunted.

In any case, the above considerations suggest that a more rationale approach to assess the nutritional status of children is to base the assessment process on weight-for-height and height-for-age standards and not on weight-for-age standards alone as weight-for-age is essentially a combination of weight-for-height and height-for-age as shown above. On the basis of weight-for-height and height-for-age criteria, the nutritional status of the child can be classified into one of the following four categories:

	$H_a > H_{ar}$	$H_a =< H_{ar}$
$W_a/H_a > W_{ar}/H_{ar}$	Normal	Under-nourished (Stunted)
$W_a/H_a =< W_{ar}/H_{ar}$	Under-nourished (Wasted)	Under-nourished (Wasted and Stunted)

The above classification is in line with the World Health Organization recommendation that under nutrition in children should be measured and monitored in a two dimensional space, one dimension of which should measure stunting while the other dimension should focus upon wasting. As recommended by the World Health Organization, stunting is capture through height-for-age index while the wasting is captures through weight-for-height index(WHO 1995). Measurement of the nutritional status of the child on the basis of weight-for-age index does not explain whether the child is stunted or wasted or both. This approach has been used in the present analysis to reassess the prevalence of under nutrition in children in India.

Nutritional Status of Children in India

In order to assess the nutritional status of the children of India in terms of the two dimensions of child growth - stunting and wasting - we have analyzed the data on height and weight of children by age available through the National Family Health Survey 1992-93, 1998-99 and 2005-06 (IIPS 1994, 2000, 2008). The National Family Health Survey is the only source which provides information on both the height and weight of children. The present analysis is based on the height and weight of 21869 children under years of age in 1992-93, 27208 children in 1998-99 and 26133 children in 2005-06 round of the survey. Using this information, we have estimated the prevalence of under nutrition in the country in terms of weight-for-age, height-for-age and weight-for-height following the methodology proposed by the World Health Organization. For each child z-scores for weight-for-age, height-for-age and weight-for-height were calculated. For estimating z-scores, the Anthro software package developed by the World Health Organization was used and the WHO standard was adopted (WHO 2010). A child having a z-score less than -2 was classified as under nourished in terms of either weight-for-age or height-for-age or weight-for-height. Finally, the prevalence of under nutrition was calculated as the proportion of children under 3 years of age who were classified as under nourished in terms of either weight-for-age or height-for-age or weight-for-height. Subsequently, the proportion of children who were stunted and wasted (SW), only stunted (S), only wasted (W) and the proportion of children who were neither stunted nor wasted was also calculated.

Figure 1
Nutritional Status of Children in Madhya Pradesh
based on different indexes

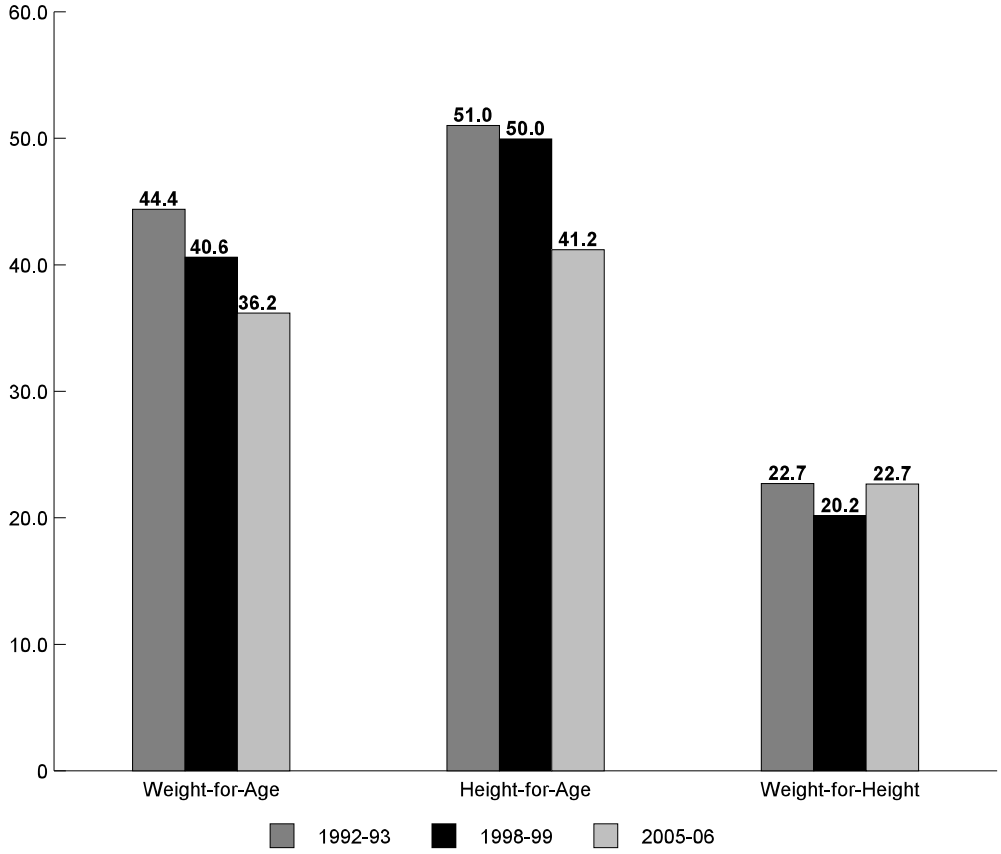


Figure 1 presents the prevalence of under nutrition in children below three years of age in terms of the three commonly used indexes of measuring and monitoring child under nutrition. When the weight-for-age criterion is used, the proportion of under nourished children below three years of age decreased from around 44 per cent in 1992-93 to around 36 per cent in 2005-06. On the other hand, when the height-for-age criterion is used, the prevalence of under nutrition in children below three years of age is estimated to have decreased from around 51 per cent in 1992-93 to around 41 per cent in 2005-06. Finally, when the weight-for-height criterion is used, the prevalence of under nutrition in children under three years of age is estimated to have decreased from around 23 per cent in 1992-93 to around 20 per cent in 1998-99 but again increased to 23 per cent in 2005-06. It is obvious that the prevalence of under nutrition varies by the criterion used. More specifically, the prevalence of under nutrition is very low when the weight-for-height criterion is used but very high when the criterion of height is used - the prevalence based on weight criterion lies in between the two. The very low prevalence of under

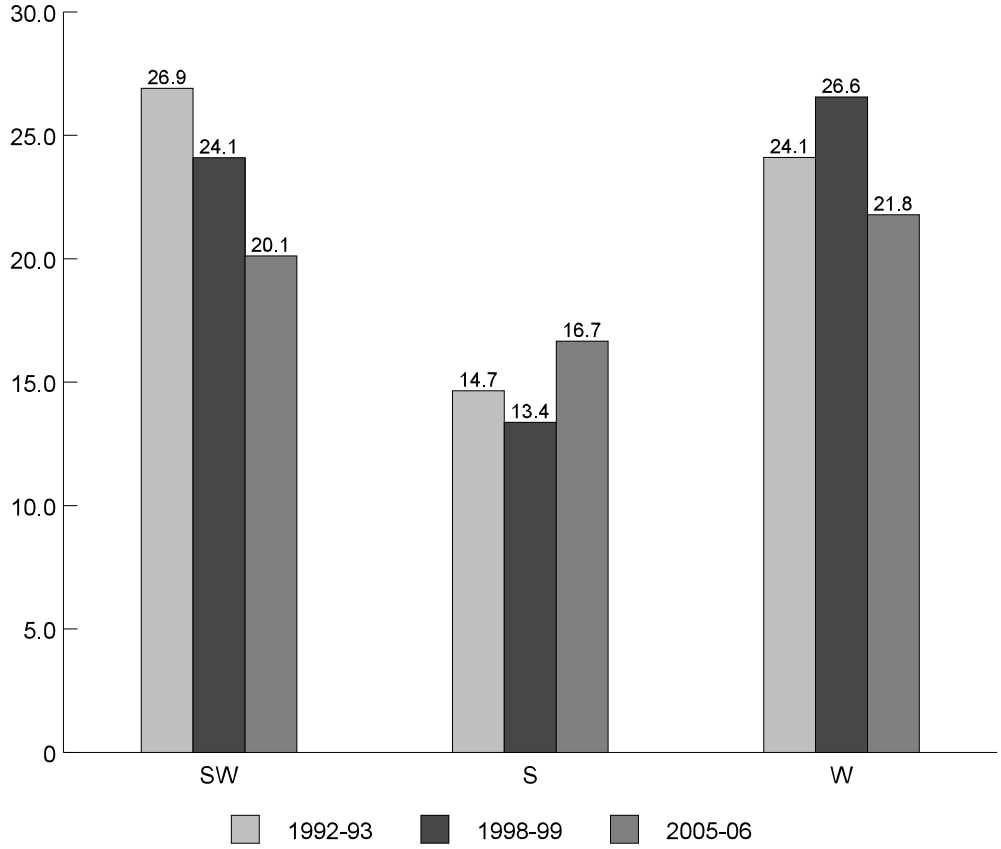
nutrition based on weight-for-height criterion is in fact misleading because of a very large proportion of children in the country are stunted as reflected through the prevalence of under nutrition based on the height criterion.

Figure 1 also provides substance to the recommendation of the World Health Organization that the nutritional status of the child should be assessed after taking into consideration both the height-for-age and the weight-for-height and not on the basis of the weight-for-age alone. Following the recommendations of the World Health Organization, a child can be classified in any of the following four categories:

The child has low height-for-age as well as low weight-for-height (SW)	The child is stunted as well as wasted. The child is under nourished in both the dimensions of child nutrition.
The child has low height-for-age only (S). The weight-for-height of the child is normal	The child is stunted but not wasted. The child is under nourished in one dimension of child nutrition.
The child has low weight-for-height only (W). The height-for-age of the child is normal.	The child is wasted but not stunted. The child is under nourished in one dimension of child nutrition.
The child has normal height-for-age as well as weight-for-height (N).	The child is neither stunted nor wasted. The child is not under nourished in any of the two dimensions of child nutrition.

The distribution of children below three years of age in India according to the above classification, is presented in figure 2. The proportion of children below 3 years of age in the country who were stunted and, at the same time, wasted, decreased from around 27 per cent in 1992-93 to around 20 per cent in 2005-06. On the other hand, the proportion of children who were stunted but not wasted increased from around 15 per cent to around 17 per cent between 1992-93 and 2005-06. Finally, the proportion of children who were wasted but not stunted decreased from around 24 per cent in 1992-93 to around 22 per cent in 2005-06. As a result, the proportion of children below 3 years of age who were not under nourished in any dimension of child nutrition(neither stunted not wasted) increased from around 34 per cent in 1992-93 to more than 41 per cent in 2005-06 according to the information available through the National Family Health Survey. In other words, almost 59 per cent children below three years of age in India were under nourished either in one or in both the dimensions of child nutrition - they were either or stunted or wasted or both. In the rural areas of the country, this

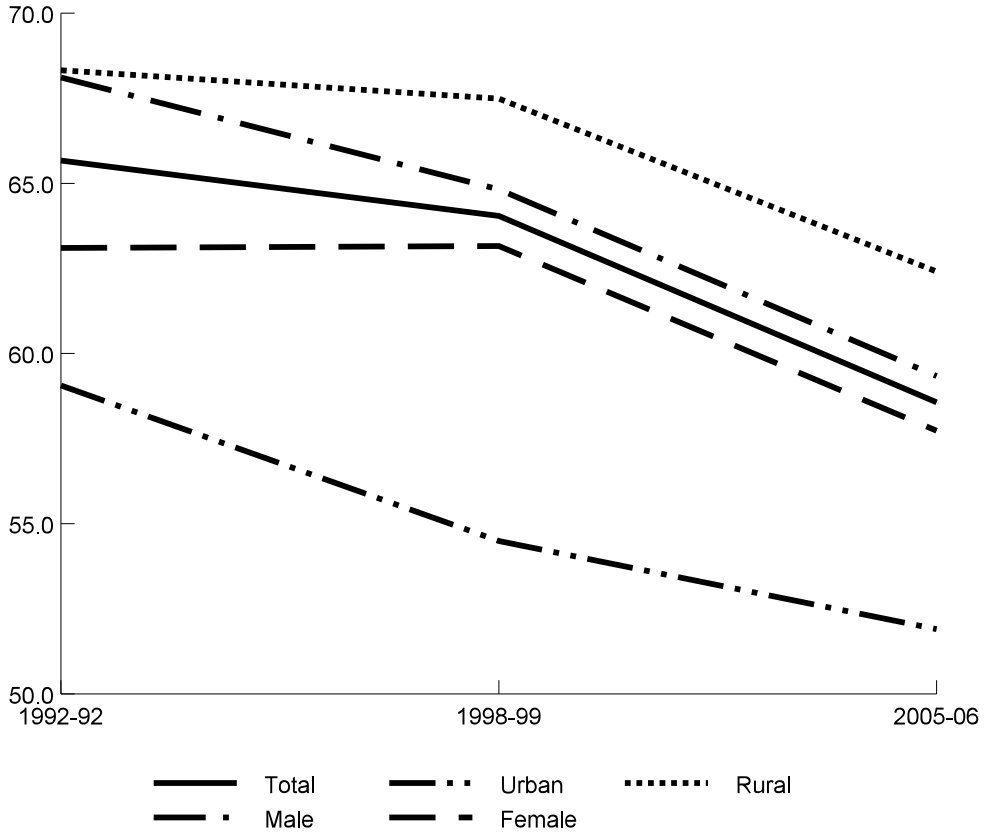
Figure 2
Two Dimensional Classification of Nutritional Status
of Children in India



proportion has been estimated to be more than 62 per cent whereas, even in the urban areas, more than half of the children below three years of age were found to be under-nourished either in one or both the dimensions of nutrition. Another important observation is that the prevalence of under-nutrition is marginally higher in male as compared to female children according to the information available through the National Family Health Survey.

The foregoing analysis emphasizes the need of adopting the two dimensional approach for measuring and monitoring the nutritional status of children the dimension of stunting and the dimension of wasting. This approach, incidentally, has been recommended by the World Health Organization but never used in India. It is evident from figure 1 and table 2 that the problem and the dimensions of child under nutrition in India is much more serious and complex than the one depicted through the conventional uni-dimensional weight-for-age, height-for-age and weight-for-height indexes. In India, identification of under-nourished children has been

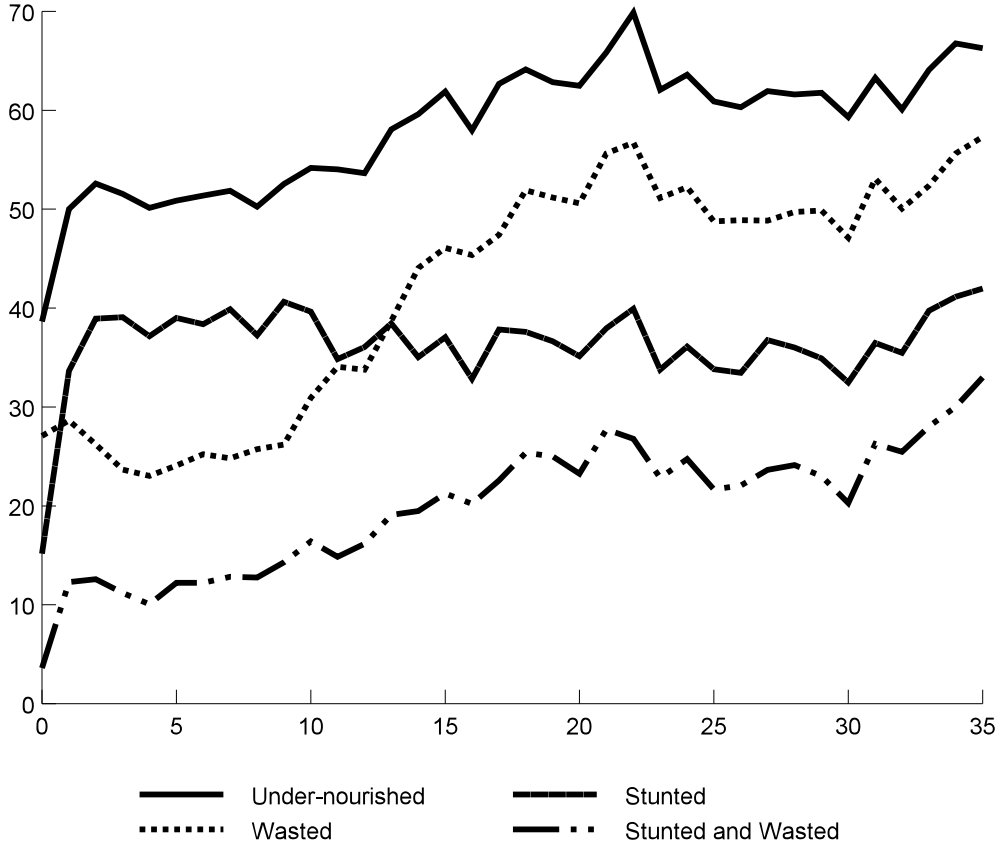
Figure 3
Trend in the prevalence of child under nutrition in India, 1992-2006



based on the historical weight-for-age approach. It is clear from the present analysis that measuring and monitoring child under nutrition on the basis of uni-dimensional indexes like weight-for-age, etc. hides more than what it reveals in the context of child under-nutrition. The justification for adopting a two dimensional approach also lies in the fact that the strategy to tackle stunting dimension of child under nutrition is radically different than the strategy to tackle the wasting dimension of child under nutrition. Moreover, it is also well established that the strategy adopted to tackle wasting in children cannot address the problem of stunting.

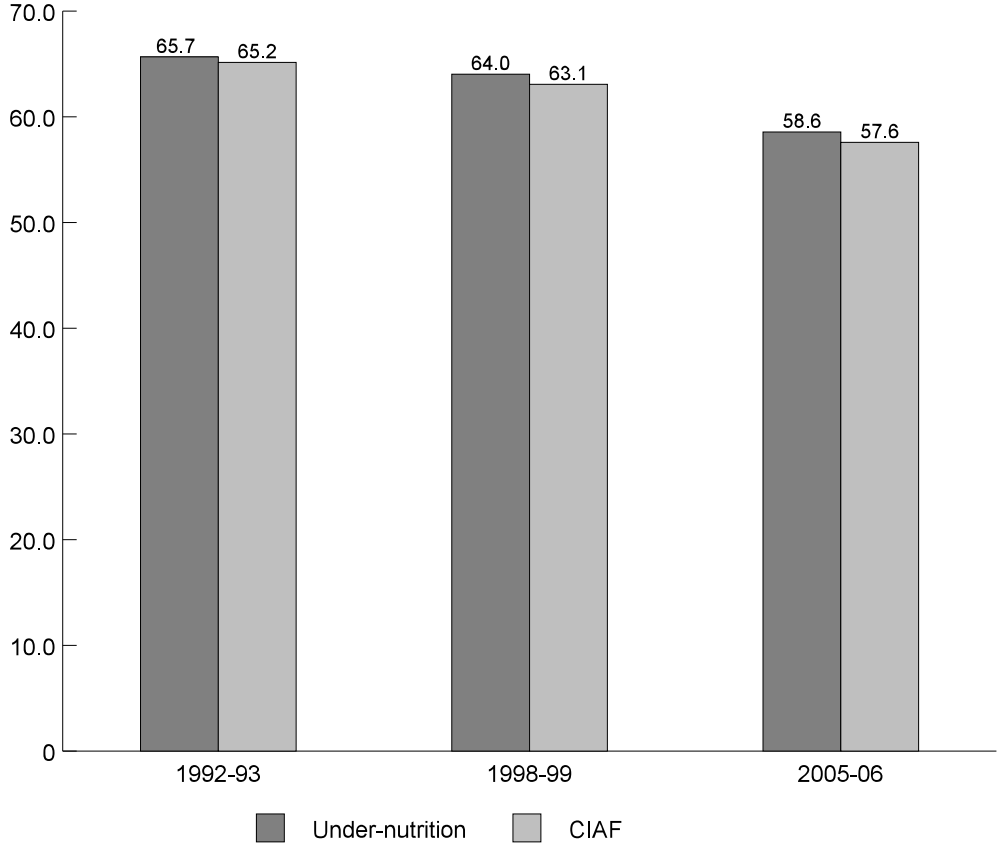
The good sign however is that the prevalence of under nutrition in the country is decreasing over time and the decrease appears to have picked up the momentum during the period 1998-99 through 2005-06 as compared to the period 1992-93 through 1998-99 according to the National Family Health Survey. However, in the urban areas of the country, the decrease in the prevalence of under nutrition appears to have slowed down in recent years as compared to the prevalence of under nutrition in the past.

Figure 4
Prevalence of under-nutrition, stunting and wasting
by age (months) of the child, India 2005-06



The age pattern of the prevalence of under-nutrition as well as age pattern of stunting and wasting, however, is disturbing as may be seen from figure 4. The prevalence of under-nutrition in the country increases up to around 2 years of age, remains more or less unchanged till 30 months of age but shows an increase after 30 years. There is no indication of the decrease in the prevalence as the child grows. On the other hand, the prevalence of stunting rises sharply in the first three months of life and then remains virtually unchanged. By contrast, the prevalence of wasting remains more or less unchanged up to ninth month of the age and then increases up to 2 years of age. Beyond 2 years of age, it also appears to remain more or less unchanged up to 30 months of age but beyond 30 months, it increases again. It is also clear from figure 4 that stunting plays a more dominant role in deciding the prevalence of under nutrition in the first nine months of life. Beyond the 9 months of age, wasting becomes increasingly dominant but role of stunting does not diminishes, it remains substantial.

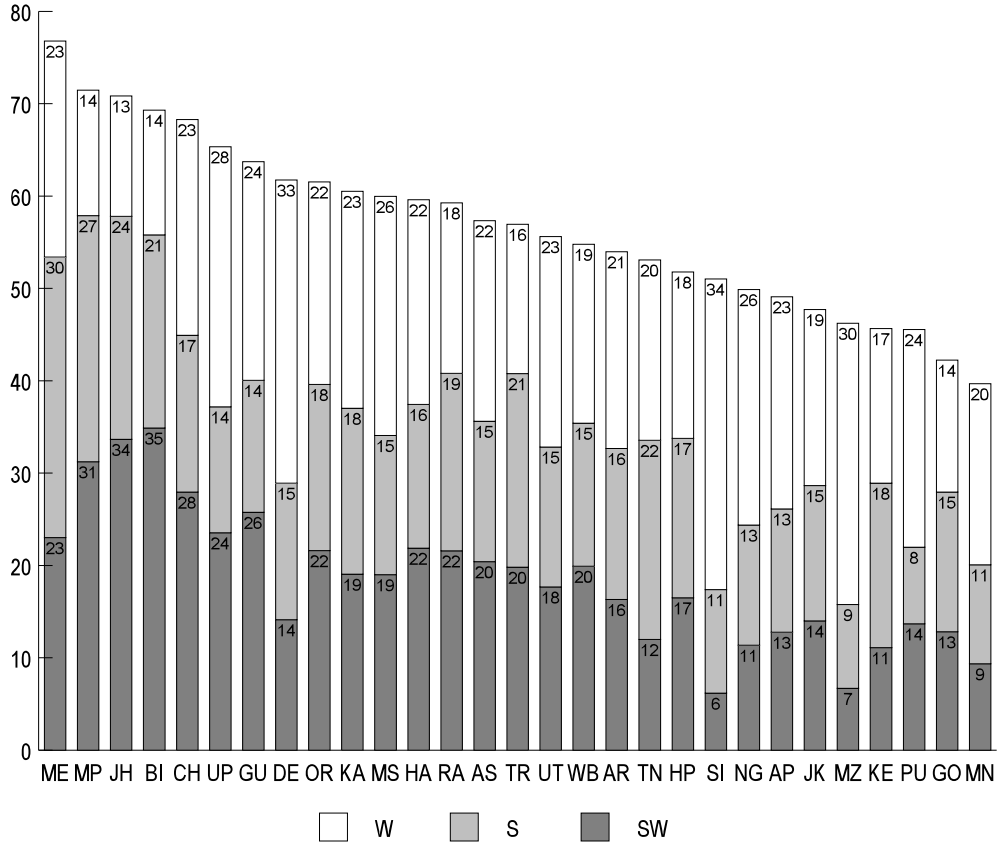
Figure 5
Prevalence of under-nutrition and comprehensive index of anthropometric failure in India: 1992-2006



A more challenging observation of the figure 4 is that there has been a rapid increase in the proportion of children who are stunted as well as the proportion of children who are wasted with the increase in the age of the child. At the time of birth, this proportion appears to be less than 4 per cent. This proportion increases to more than 25 per cent by 21-22 months of age and remains very close to this proportion till 30 months of age. After 30 months of age, this proportion increases again to reach an all age high of around 33 per cent by 35 months of age.

It would be interesting to examine how our approach compares with the approach suggested by Svedberg (2001). For this purpose, we have calculated the comprehensive index of anthropometric failure (CIAF) in children below three years of age in India in 1992-93, 1998-99 and 2005-06 as suggested by Svedberg and compared it with the prevalence of child under-nutrition estimated on the basis of the approach described in this paper (Figure 5). It is clear that the two approaches provide nearly the same prevalence of child-under nutrition. This close

Figure 6
Prevalence of under-nutrition in Indian states, 2005-06



proximity of our estimates of the prevalence of child under-nutrition with estimates of CIAF provides credence to our approach of measuring and monitoring child under nutrition. It also confirms that the prevalence of under-nutrition based on the proportion of under-weight children remains a gross under estimate of the true prevalence of under-nutrition in the country.

Finally, figure 6 presents the state specific analysis of child under-nutrition. According to the National Family Health Survey 2005-06, the prevalence of under nutrition has been found to be the highest in Meghalaya where almost 77 per cent of children below 3 years of age were found to be under nourished in either one or both the dimensions of under-nutrition. In Madhya Pradesh and Jharkhand also, the prevalence of under-nutrition has been estimated to be more than 70 per cent. Besides, there are 7 states - Bihar, Chhattisgarh, Uttar Pradesh, Gujarat, Delhi, Orissa and Karnataka - where the prevalence of under nutrition ranged between 60-70 per cent. On the other hand, Manipur is the only state in the country where the prevalence of child under-nutrition has been estimated to be less than 40 per

cent. In Nagaland, Andhra Pradesh, Jammu and Kashmir, Mizoram, Kerala, Puducherry and Goa, the prevalence of child under-nutrition ranged between 40-50 per cent.

As regards the proportion of children who were stunted as well as wasted, Bihar tops the list with a proportion of almost 35 per cent followed by Jharkhand (34 per cent) and Madhya Pradesh (31 per cent). In Assam, Rajasthan, Orissa, Haryana, Meghalaya, Uttar Pradesh, Gujarat and Chhattisgarh, this proportion ranged between 20-30 per cent whereas in Sikkim, Manipur and Mizoram, it was estimated to be less than 10 per cent. This proportion was also low in eight other states of the country.

It is obvious from the foregoing analysis that a two dimensional approach of measuring and monitoring child under-nutrition is more appropriate to capture the complexity in child under-nutrition the single dimension approach such as weight-for-age. When the child under nutrition is measured on a two dimensional plane - the dimension of stunting and the dimensions of wasting - the prevalence of child under-nutrition in the country is estimated to be substantially higher and the problem of child under-nutrition much more serious and complex then when child under nutrition is measured in one dimension only.

Combating Child Under-nutrition

The policy response to combat child under-nutrition in India has been the Integrated Child Development Scheme (ICDS) which was launched on a small scale in 1975 following the announcement of the National Policy on Children in 1974. Subsequently, the Government of India announced the National Policy on Nutrition in 1993 which was followed by the National Nutrition Plan of Action in 1995 but both the National Nutrition Policy and the National Nutrition Plan of Action largely remains on paper because of the lack of sufficient resources and proper monitoring of the implementation of the policy and the plan of action. The fact remains that interventions directed towards addressing child under nutrition in the country are literally confined to ICDS only, although a range of programmes may be identified that are claimed to have an impact on child under nutrition (Ramchandran 2007).

The nutrition component under the ICDS includes the following interventions:

- Nutrition education of mothers for improving dietary intake and dietary diversity.
- Nutrition education about proper infant and young child feeding practices.
- Growth monitoring and detection of growth faltering.
- Food supplementation to children 6 months to 6 years of age and to all pregnant women and lactating mothers.

The interventions are implemented through the chain of Aanganwadi Centres which have now been established throughout the country, although the coverage of these interventions is still not universal. The Aanganwadi Worker - essentially, a minimally trained voluntary worker - is responsible for providing a range of services

through these centres including services that address the nutritional status of children. A recent review has however observed that, over the years, the Aanganwadi centres have virtually reduced to the centre for distributing supplementary food while other components of ICDS, particularly, growth monitoring has been seriously neglected (Ramchandran 2007).

Growth monitoring under ICDS comprises of monthly weighing of all children under 3 years of age in the area covered by the Aanganwadi centres, quarterly monitoring of all children 3-6 years of age and maintaining the growth card for every child under 6 years of age at the centre. Interestingly, ICDS does not cater the needs of children above 6 years of age. Moreover, growth monitoring is confined to only child weighing and classifying the nutritional status of the child on the basis of its weight following the standard proposed by the Indian Academy of Paediatrics (1972). There is no recording of length or height of the child so that measuring and monitoring of the nutritional status of the child is based on the weight of the child only. Accordingly, the only intervention to combat child under nutrition is the food supplementation. Other issues related to child under-nutrition have grossly been ignored under the ICDS. One compelling factor is that the minimally trained voluntary Aanganwadi worker who is responsible for the delivery of services at the Aanganwadi centre is not competent to deliver other services including measuring and monitoring height and weight-for-height.

The nutrition component of ICDS has been the subject of frequent programmatic research. A synthesis of these research is given in Ramchandran (2007). Perhaps, the most important conclusion of these research studies is that there is a mismatch what is being provided through ICDS and what is needed to combat child under nutrition. For example, it is well known that the first 24 months are critical for preventing under nutrition but it has been observed that children below 3 years of age are the least likely to attend the Aanganwadi centre. Similarly, it has been found that there is no association of the presence of Aanganwadi centre in a village and the likelihood of a child in the village being under nourished (under-weight).

Findings of the present analysis also highlight the gross inadequacy of the official response to combat child under nutrition. The policy and programme implications of the analysis presented here are loud and clear. They can be summarised as under:

- The dynamics of child growth and nutrition is too complex to be captured by just one anthropometric criterion, especially the weight of the child, as is currently the practice under ICDS.
- Measuring and monitoring child growth and nutrition should be based on height and weight-for-height as recommended by the World Health Organization and not on the basis of the weight alone as is the practice at present.
- A two dimensional approach should be adopted to address the problem of under-nutrition in children. One dimension of the approach should focus on

stunting while the other should concentrate on wasting. It is important to keep in mind that a child may not be wasted simply because it is stunted.

- Adopting a two-dimensional approach is necessary because risk factors of stunting essentially different from those of wasting. The key risk factors for stunting are low birth weight and short previous birth interval whereas illness (diarrhoea, severe respiratory infections or both) is the most consistent risk factor for wasting. Diarrhoeal morbidity increases the risk of wasting in infants almost four times.
- Two-dimensional approach is also necessary in view of the fact that wasting often develops very rapidly and can also be reversed quickly. This is however not the case with stunting.
- Both stunting and wasting can be prevented as well as treated. The preventive approach leads to a reduction in the prevalence of under-nutrition. The treatment approach does not affect the prevalence of under-nutrition as it does not address the main risk factors of under nutrition. A child may be under-weight because it is either stunted or wasted or both.
- Just measuring and monitoring the weight of child is not enough to prevent under-weight. Weight of the child does not tell whether the growth faltering (in terms of weight) is due to linear growth faltering or due to poor gain in weight in relation to the height or both.
- Food supplementation is not sufficient to address the problem of under-nutrition. A child may be under-weight because of either environmental factors or physiological factors. Environmental factors are related to the availability and distribution of food. Physiological factors are related to ingestion and the process of absorption of the food by the body. Food supplementation address only the environmental factors. It does not address the physiological factors.

A preventive approach, therefore, needs to be adopted in place of the treatment approach which has been adopted at present to combat child under-nutrition. However, the preventive approach, at best, is a long term strategy. It cannot be institutionalized immediately. Moreover, it cannot address the immediate and short term needs of those children who have already been detected as under-nourished - stunted or wasted or both. It is therefore necessary to continue with the current selective treatment approach, albeit with a different orientation and, at the same time, introducing and institutionalizing the preventive approach to combat child under-nutrition. At the same time, in order to make the selective treatment approach effective, it is imperative that the approach must be oriented toward early childhood development and must not be confined to just food supplementation.

Introducing the preventive approach to combat child under-nutrition and reorienting the selective treatment approach so that it is directed towards early childhood development rather than treating under-nutrition, requires a thorough restructuring of ICDS, the flagship scheme of the Government of India. There is an immediate need

of putting in place a fully functional unit at the grass roots level to provide a range of services to women and children necessary to address the two dimensions of child under-nutrition - the dimension of stunting and the dimension of wasting. The current organisation including the infrastructure, the manpower and the services provided totally mismatches with what is actually needed to address the problem of under-nutrition in the community. It is very much evident that the dimensions of child under-nutrition are too alarming and too complex to be addressed through such minimally trained voluntary service provider as the Aanganwadi worker who works in near total isolation and has extremely limited capacity and opportunity to improve her knowledge and skills to match the needs of the community. This restructuring is all the more important in view of the fact that child under-nutrition has serious implications for the social and economic development processes via the poor productive capacity of an average individual. It needs to tackled on war footings. During the Eleventh Five-year Plan, it was envisaged that the ICDS will be run on a mission. However, the current evidence suggests that there has been little change, especially at the grass roots level, the interface with the community.

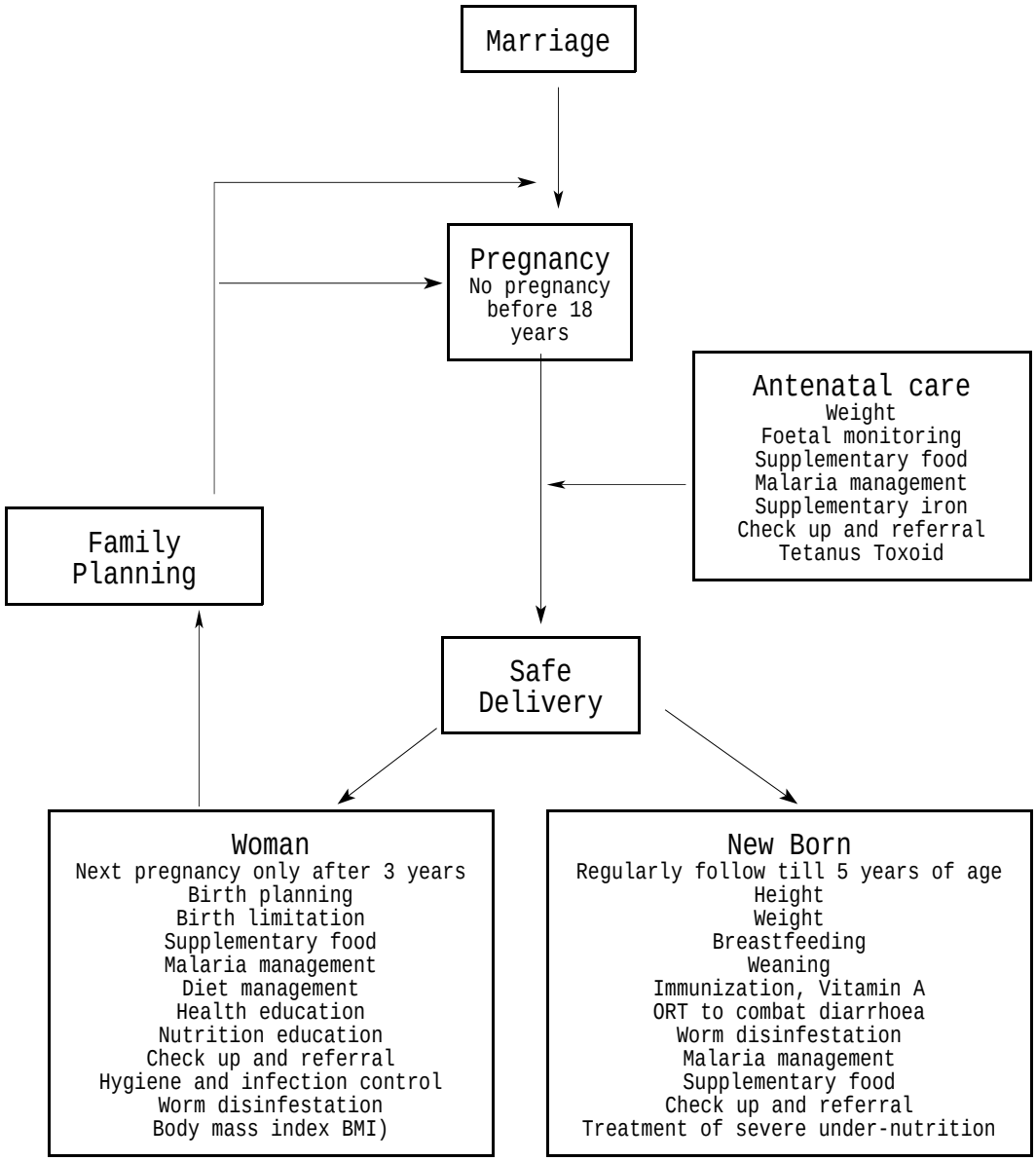
An Alternative Framework

Combating child under-nutrition requires an agent (a set of specific interventions), a way or the means to get the agent to women and children in need of the agent (the delivery strategy) and a monitoring system that effectively ensures that the agent is reaching those who need it. The agent necessary to combat child under-nutrition is derived from the close link between maternal under-nutrition, low birth weight, childhood stunting and underweight that is now being revealed with its inter-generational implications (Perez-Escamillia et al. 1995). As such, the agent for combating child under-nutrition is based on the premise that prevention of child under-nutrition is contingent upon the prevention of intrauterine growth retardation and early detection and correction of under-nutrition during infancy and early childhood. It has the following five essential elements:

1. Comprehensive care of women during pregnancy.
2. Proper infant care and feeding.
3. Prevention of communicable diseases.
4. Timely and rational management of childhood illness.
5. Reducing poverty and associated food shortage.

On the other hand, the delivery strategy should ensure universal reach of the agent. If the delivery strategy is not able to ensure universal reach, it will not be possible to achieve and maintain nearly universal coverage rates which, in turn, will render the agent ineffective. It is important to note here that unlike the agent which is now nearly universally established and accepted, there is no universally agreed delivery strategy. The strategy to get the agent to women and children in need depends upon a host of local factors and therefore varies from location to location.

Figure 7
Preventive approach to combat child under-nutrition



In the above context, it would be revealing to examine up to what extent the agent necessary for combating under-nutrition is delivered ICDS. Since, all services under the ICDS are delivered through the Aanganwadi centre only, a comparison of the services prescribed to be delivered through the Aanganwadi centre with the agent described above facilitates this examination (Table 1). It is obvious from table 1 that

the services prescribed under ICDS are grossly inadequate as key elements of the agent necessary to prevent child under-nutrition are missing. Moreover, and as discussed earlier, the services prescribed to be delivered through the Aanganwadi centre are heavily biased towards supplementary feeding and nutrition and health education, the effectiveness of which is very much doubtful given the prevailing social and economic situation and living conditions of the common Indian. Moreover, there is no provision in ICDS to address severe under-nutrition other than doubling the supplementary feeding. Obviously, ICDS is not going to cut much ice in neither preventing nor treating child under-nutrition.

Table 1
Comparison of the agent necessary for combating child under-nutrition and the services prescribed at the Aanganwadi centre.

Components of the agent	Services prescribed at the Aanganwadi centre
Comprehensive care of women during pregnancy	1. Supplementary feeding to pregnant women and lactating mothers. 2. Referral services 3. Nutrition and health education.
Proper infant and child care and feeding	1. Supplementary feeding. 2. Growth monitoring. 3. Referral services. 4. Health and nutrition education.
Prevention of communicable diseases	1. Immunization. 2. Vitamin A prophylaxis. 3. Health education.
Timely and rational management of childhood illnesses	1. Health check up. 2. Referral services.
Reducing poverty and associated food shortage	1. Supplementary feeding.

Finally, and perhaps the most important requirement for effectively combating child under-nutrition is that there should be mechanism to ensure that the delivery strategy is efficient so that the reach of the agent is universal and the agent is really effective in reducing the prevalence of under-nutrition. This means that there should be a measuring and monitoring mechanism which ensures that every child is properly followed before birth and at least five years after the birth to detect growth faltering as early as possible so that appropriate remedial action is taken.

Without such a mechanism, it is difficult to ensure that the delivery strategy is efficient and the agent effective. The importance of regular follow-up of every child right since conception is critical in view of the fact that once under-nutrition sets in at any time after the conception, it is very difficult to reverse the process irrespective of the nature and composition of the agent and the efficiency of the delivery strategy. Monitoring the growth and development of the child is therefore critical in preventing under-nutrition.

Figure 7 presents an operational framework to institutionalize the preventive approach to combat child under-nutrition. The critical element that runs through the operational framework is the follow up of the woman and the child right from conception up to five years of age. The starting point of the operational framework is the marriage. Selecting marriage as the starting point has a number of merits. First, procreation in India is virtually confined to the institution of marriage. Second, marriage, in traditional Indian settings, is a very well known family and social event which can be recognized easily which facilitates universal registration. This is not the case with pregnancy as detection of pregnancy, especially in the first trimester, is extremely difficult in the typical rural settings. There is generally a cultural taboo of not disclosing the pregnancy till there are clear physical changes in the body of the female to safeguard the pregnancy against bad evils. and registration of all marriage. Third marriage, invariably, leads to pregnancy and a critical issue in the context of child under-nutrition is that there should be no pregnancy before 18 years of age.

The second important component of the operational framework of comprehensive pre-natal care of all pregnant women. The critical elements in this care are regular recording of weight of the women so as to ensure that with the progress of pregnancy she is gaining adequate weight. Normal weight gain during pregnancy ensures that the growth of the foetus is normal. If the weight gain during pregnancy is not normal, the woman may be provided supplementary food. Other critical elements of pre-natal care include foetal monitoring and monitoring of the movement of the foetus. Finally, prophylaxis against anaemia may be given to all women to combat anaemia during pregnancy.

The third critical element of the operational framework is the safe delivery. Safe delivery means either institutional delivery or non-institutional delivery attended by professionally trained persons. here the critical elements are the recording to birth weight and APGAR score of the child to ascertain whether the new born needs specialized medical attention or not. This is important because a prompt action immediately after delivery can contribute significantly to preventing the onset of under-nutrition by taking appropriate remedial measures.

Finally, the fourth component of the operational framework is related to the follow up of the new born up to five years of age. Critical elements in this follow up are regular monitoring of height and weight of the child to ensure that the growth of

the child is not faltering as well as full immunization, Vitamin A, supplementary food, etc. The framework also emphasizes a gap of at least three years in the next pregnancy to give sufficient time to the woman to recover from the previous pregnancy and to provide adequate care to the child. In this context, family planning is an important component for combating child under-nutrition.

It is obvious that the operational framework described above cannot be implemented through the current structure and organisation of ICDS. It is in this context that the following delivery strategy is proposed:

1. The most crucial intervention that is being proposed is to establish Gram Panchayat Nutrition and Health Network in every Gram Panchayat of the country. This Network should work towards establishing a fully functional Nutrition and Health Resource Centre in every Gram Panchayat of the country to address the nutrition and health needs of the people (children) of the Gram Panchayat. The proposed Gram Panchayat Nutrition and Health Network will be fully owned by the Gram Panchayat and will supplement, not complement, the existing public health and nutrition services.
2. In order to provide financial and technical support to the Gram Panchayat Nutrition and Health Network, a National Nutrition and Health Board may be established through an Act of the Parliament as an independent, autonomous organisation. This Board should function independent of the existing public administration system and must be responsible and accountable to the people of the country. The Board will submit its report on the nutrition situation in the country to the Parliament every year.
3. The Board will provide support to Gram Panchayat Nutrition and Health Network on a performance basis, although the Network will be free to generate its own resources for the expansion and development of the Gram Panchayat Nutrition and Health Resource Centre. Performance indicators may be developed for the purpose which will be related to both impact and outcome indicators as well as process and output indicators.
4. The proposed National Nutrition and Health Board will have members with expertise in the field of nutrition and health and other related fields. All the members must be the full time members of the Board. The Board will have its own secretariat and managerial structure. It will work independent of government agencies and organizations.
5. The effectiveness of the Gram Panchayat Nutrition and Health Resource Centre will ultimately depend upon the quality and efficiency of nutrition and health services delivered through the Centre. For this purpose, the Gram Panchayat Nutrition and Health Centre will be manned by at least two (one male and one female) thoroughly trained and competent nutrition and health care providers. The existing Aanganwadi Worker is neither adequately trained nor is competent for the purpose. She has never been conceived as service

provider. This is a false preposition which needs to be rejected at the outset. The pandemic of under nutrition cannot be addressed through the Aanganwadi Worker.

6. The National Nutrition and Health Board will be responsible for the training of Gram Panchayat Nutrition and Health Care Provider. Selection of the candidates for training will be done by the Gram Panchayat while norms for selection may be laid down by the Board. Actual training may be organised at polytechnics and industrial training institution for which the Board may provide support. The examination may be conducted by the Board at the national level. Only those candidates who successfully complete the training will be eligible for appointment as by the Gram Panchayat as Gram Panchayat Nutrition and Health Care provider. The government will have no role in this appointment.
7. The existing Aanganwadi Workers will also be eligible for the training provided they have been nominated by the Gram Panchayat. Their appointment as Gram Panchayat Nutrition and Health Care Provider by the Gram Panchayat will however be contingent upon successfully completing the training programme.
8. With the creation of the Gram Panchayat Nutrition and Health Network, all Aanganwadi centres will be transferred to the Network for all administrative and managerial control. All Aanganwadi centres in a Gram Panchayat will be linked to the Gram Panchayat Nutrition and Health Resource Centre as the extended arm of the Centre.
9. The existing minimally trained voluntary Aanganwadi Worker must be replaced by a full time thoroughly trained and adequately skilled Village Nutrition and Health Worker who can follow up each and every child rights from conception up to five years of age in an effective manner. This village level worker will work in tandem with the Gram Panchayat Nutrition and Health Care providers.
10. Establishment of new Aanganwadi centres will be the prerogative of the Gram Panchayat Nutrition and Health Network. The ultimate objective is that every village in the rural areas of the country has at least one Aanganwadi centre which is affiliated to the Gram Panchayat Nutrition and Health Resource Centre for all operational purposes. The National Nutrition and Health Board may support the Gram Panchayat Nutrition and Health Network in establishing new Aanganwadi centres on the basis of the performance of the Gram Panchayat Nutrition and Health Resource Centre.
11. In every development block of the country, a Block Nutrition and Health Resource Centre should be established to provide technical and managerial support to Gram Panchayat Nutrition and Health Network within the development block. The proposed Resource Centre will also be responsible to assess the nutrition and health situation in each Gram Panchayat every year.

This assessment, in combination with the report of the Gram Panchayat, will constitute the basis for the providing financial support to the Network.

12. The Block Nutrition and Health Resource Centre will support the Gram Panchayat Nutrition and Health Network in designing interventions to address issues related to child under-nutrition on the basis of the situation specific to the Gram Panchayat. These interventions will be implemented by the Network through the Gram Panchayat Nutrition and Health Resource Centre.
13. The Block Nutrition and Health Resource Centre will also be responsible for establishing and managing block level child nutrition information system. This information system will have three components - routine height and weight recording system, community surveillance system and annual nutrition survey in the block. Triangulation of the information from the three components will be done to assess the nutrition situation in the block.
14. The framework being proposed here does not envisage any district level establishment. The underlying philosophy is that the National Nutrition and Health Board will be able to deal directly with the Block Nutrition and Health Resource Centres and even to Gram Panchayat Nutrition and Health Network through the application of the tools and techniques of information technology.

The alternative framework being proposed here is based on the key assumption that combating under-nutrition is critically contingent upon following each and every child right from conception up to at least five years of age - a recommendation put forward by the First Health Survey and Development Committee way back in 1946 but is yet to be implemented (Government of India 1946). The framework also emphasizes two dimensional approach to measuring and monitoring child growth and development to detect growth faltering so as to take remedial measures as early as possible. This is important from two perspectives. First, the two dimensional approach reflects the true magnitude of the problem of child under-nutrition as shown in the present paper. Second, the relative contribution of the two dimensions of child under-nutrition to the over all level of child under-nutrition varies with age.

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Table 2
Prevalence of under-nutrition in India, 1992-2006

Population	Period	Proportion (per cent) of children below 3 years of age			Prevalence (per cent) of		
		Stunted and wasted (SW)	Stunted but not wasted (S)	Wasted but not stunted (W)	Under-nutrition	Stunting	Wasting
Total	1992-93	26.91	14.65	24.11	65.67	41.56	51.02
	1998-99	24.10	13.38	26.56	64.04	37.48	50.66
	2005-06	20.12	16.66	21.79	58.57	36.78	41.91
Urban	1992-93	21.75	13.96	23.35	59.06	35.71	45.10
	1998-99	17.98	12.53	23.98	54.49	30.51	41.96
	2005-06	14.89	15.78	21.23	51.90	30.67	36.12
Rural	1992-93	28.98	14.92	24.42	68.32	43.90	53.40
	1998-99	26.31	13.69	27.49	67.49	40.00	53.80
	2005-06	23.13	17.17	22.11	62.41	40.30	45.24
Male	1992-93	28.80	14.81	24.50	68.11	43.61	53.30
	1998-99	24.57	13.29	26.96	64.82	37.86	51.53
	2005-06	20.93	16.19	22.22	59.34	37.12	43.15
Female	1992-93	24.93	14.47	23.70	63.10	39.40	48.63
	1998-99	23.57	13.48	26.11	63.16	37.05	49.68
	2005-06	19.24	17.17	21.32	57.73	36.41	40.56

Source: Author's calculations

Table 3

Prevalence of child under nutrition in India by age, 1992-2006

Age in years	Proportion (per cent) of children below 3 years of age			Prevalence of under-nutrition	Proportion of children stunted	Proportion of children wasted
	Stunted and wasted (SW)	Stunted but not wasted (S)	Wasted but not stunted (W)	(Per cent)	(Per cent)	(Per cent)
0	3.61	11.55	23.47	38.63	15.16	27.08
1	12.30	21.36	16.34	50.00	33.66	28.64
2	12.58	26.36	13.64	52.58	38.94	26.23
3	11.20	27.87	12.46	51.54	39.08	23.67
4	10.05	27.10	12.98	50.13	37.15	23.03
5	12.22	26.77	11.86	50.86	39.00	24.08
6	12.22	26.14	13.00	51.37	38.36	25.23
7	12.84	27.04	11.98	51.85	39.88	24.81
8	12.75	24.50	13.00	50.25	37.25	25.74
9	14.30	26.34	11.90	52.54	40.64	26.20
10	16.40	23.25	14.52	54.17	39.65	30.91
11	14.86	19.97	19.20	54.02	34.83	34.06
12	16.17	19.89	17.60	53.65	36.05	33.76
13	19.08	19.36	19.64	58.08	38.44	38.72
14	19.48	15.56	24.58	59.61	35.03	44.05
15	21.25	15.80	24.83	61.89	37.05	46.08
16	20.21	12.63	25.13	57.98	32.85	45.35
17	22.57	15.26	24.84	62.67	37.83	47.41
18	25.37	12.23	26.53	64.13	37.60	51.90
19	25.00	11.65	26.18	62.83	36.65	51.18
20	23.25	11.89	27.34	62.48	35.14	50.59
21	27.74	10.21	27.90	65.85	37.96	55.64
22	26.78	13.16	29.95	69.89	39.94	56.73
23	22.83	10.93	28.30	62.06	33.76	51.13
24	24.73	11.37	27.50	63.59	36.10	52.23
25	21.68	12.13	27.10	60.90	33.81	48.77
26	22.05	11.41	26.85	60.31	33.46	48.90
27	23.65	13.11	25.19	61.95	36.76	48.84
28	24.13	11.87	25.60	61.60	36.00	49.73
29	23.02	11.90	26.85	61.77	34.92	49.87
30	20.28	12.20	26.83	59.31	32.48	47.11
31	26.27	10.20	26.80	63.27	36.47	53.07
32	25.46	10.01	24.61	60.09	35.48	50.07
33	28.03	11.70	24.35	64.08	39.73	52.38

Age in years	Proportion (per cent) of children below 3 years of age			Prevalence of under-nutrition	Proportion of children stunted	Proportion of children wasted
	Stunted and wasted (SW)	Stunted but not wasted (S)	Wasted but not stunted (W)	(Per cent)	(Per cent)	(Per cent)
34	30.01	11.13	25.62	66.76	41.14	55.64
35	33.00	8.97	24.31	66.28	41.97	57.31

Source: Author's calculations

Table 4
Prevalence of child under nutrition in Indian states, 1992-2006

State	Proportion (per cent) of children below 3 years of age			Prevalence of under-nutrition	Proportion of children stunted	Proportion of children wasted
	Stunted and wasted (SW)	Stunted but not wasted (S)	Wasted but not stunted (W)	(%)	(%)	(%)
Andhra Pradesh	12.79	13.34	22.96	49.09	26.13	35.75
Arunachal Pradesh	16.33	16.33	21.32	53.97	32.65	37.64
Assam	20.42	15.21	21.72	57.35	35.63	42.13
Bihar	34.90	20.89	13.52	69.31	55.79	48.42
Chhattisgarh	27.95	16.98	23.35	68.28	44.93	51.30
Delhi	14.13	14.78	32.83	61.74	28.91	46.96
Goa	12.84	15.11	14.29	42.24	27.95	27.12
Gujarat	25.76	14.29	23.69	63.74	40.05	49.45
Haryana	21.88	15.57	22.17	59.62	37.44	44.05
Himachal Pradesh	16.51	17.26	18.01	51.78	33.77	34.52
Jharkhand	33.66	24.15	13.05	70.85	57.80	46.71
Jammu & Kashmir	14.01	14.66	19.06	47.72	28.66	33.06
Karnataka	19.07	17.97	23.48	60.53	37.05	42.56
Kerala	11.11	17.81	16.75	45.68	28.92	27.87
Meghalaya	23.02	30.37	23.40	76.79	53.38	46.42
Manipur	9.37	10.72	19.61	39.71	20.10	28.99
Madhya Pradesh	31.25	26.63	13.60	71.47	57.87	44.85
Maharashtra	19.00	15.09	25.88	59.97	34.10	44.88
Mizoram	6.70	9.07	30.45	46.22	15.77	37.15
Nagaland	11.37	13.01	25.50	49.87	24.38	36.86
Orissa	21.62	17.98	21.93	61.54	39.60	43.56
Punjab	13.68	8.30	23.58	45.56	21.98	37.26
Rajasthan	21.59	19.21	18.48	59.29	40.81	40.07
Sikkim	6.19	11.21	33.63	51.03	17.40	39.82
Tamil Nadu	12.00	21.55	19.53	53.08	33.55	31.53
Tripura	19.83	20.96	16.15	56.94	40.79	35.98
Uttar Pradesh	23.54	13.65	28.16	65.35	37.19	51.70
Uttarakhand	17.69	15.14	22.79	55.62	32.83	40.48
West Bengal	19.93	15.49	19.36	54.78	35.42	39.29
	20.12	16.66	21.79	58.57	36.78	41.91

Source: Author's calculations