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Assessing Child Malnutrition: Some Basic Issues

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Over the past three decades, there has been a slow but definite decline in the under-five and infant mortality rates in India[1]. Concern has been expressed that this enhanced survival may be simply adding to the pool of substandard undernourished children, the human resource of tomorrow. It is, therefore, logical to direct increasing attention to the 'quality' of the survivors. Nutritional status is an important index of this quality. It is necessary to find out if, in fact, significant reduction in child mortality in recent years has contributed to swelling the ranks of the undernourished children.

In developing countries, anthropometry, despite its inherent limitations, still remains the most practical tool for assessing the nutritional status of children, in the community[2]. The only reliable source for the evaluation of nutritional status of under-five children in India (till 1991) was the periodic survey based on nutritional anthropometry[3,4] conducted by the National Nutrition Monitoring Bureau (NNMB). According to pooled data from the eight states covered by NNMB, national projections of nutrition trends have been made[5]. However, the NNMB operations did not include states such as Bihar, Uttar Pradesh, Rajasthan, Punjab and West Bengal, which together account for over 40 per cent of India's child population.

From the recently concluded National Family Health Survey (NFHS)[6] country-wide data on nutritional anthropometry of under-five children are now becoming available. The emphasis in this survey was on fertility and reproductive status, but some data related to child nutrition have also been included. In spite of obvious sampling, methodological and analytical differences between the NNMB and the NFHS operations, comparisons of nutritional profile assessed by these two different sources (NNMB and NFHS) are sometimes being attempted, and inferences regarding changing trends in child nutrition status are being drawn.

This communication is primarily intended to focus attention on the possible pitfalls in such comparisons and inferences drawn. An attempt is made here to recapitulate even at the risk of some repetition, some of the basic issues involved in the assessment of the nutritional status of children in communities using anthropometric parameters.

ASSESSMENT OF NUTRITIONAL STATUS OF A POPULATION

For a truly valid picture of a population's nutritional profile, we need to have information on the distribution of a population according to nutritional status. However, for reasons of simplicity, computational ease and operational feasibility, it is customary to refer to a single index, that is, the percentage of 'abnormal' or 'malnourished' children in the community using admittedly arbitrary cut-off points. In fact, national goals are often oriented towards the reduction of the percentage of 'malnourished' subjects so identified rather than towards an improvement of the overall nutritional profile as reflected by a shift in the entire distribution. A brief recapitulation of the pertinent aspects in the identification of malnourished children is, therefore, imperative for a better comprehension of the issues and the limitations of the current approaches.

ANTHROPOMETRIC CLASSIFICATIONS

The earlier classifications were based on a comparison of the weight of the child with the average (or median) weight of a child of the same age and sex from a reference (or standard) population; this index being referred to as weight-for-age. Gomez's classification of malnutrition was the first one to be proposed from Mexico[7] on the basis of prognostication studies in hospitalised children. Three grades of malnutrition were identified on the basis of their weight-for-age in comparison with the 'standard' Harvard reference population[8]: Normal:>90 per cent of reference weight-for-age;

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Grade I: 90-75 per cent; mild malnutrition; Grade II: 75-60 per cent; moderate malnutrition; and Grade III: <60 per cent; severe malnutrition.

In 1972, the Nutrition Sub-Committee of the Indian Academy of Paediatrics (IAP) proposed the popular IAP classification of malnutrition[9], again on the basis of the Harvard reference population as the standard: Normal: >80 per cent of standard weight-for-age; Grade I: 71-80 per cent; Grade II: 61-70 per cent; Grade III: 51-60 per cent; and Grade IV: ≤50 per cent. Usually Grades III and IV are referred to as severe malnutrition. A suffix 'K' (for kwashiorkor) was proposed for a child with pedal oedema.

Drawbacks of the above classifications are, firstly, that the Harvard data are no longer recognised as an international reference and are not easily available. The current consensus is to use the National Centre for Health Statistics (NCHS) data[10] as the international reference standard. In a large-scale multicentric study, the Nutrition Foundation of India (NFI) had investigated the validity of the use of this NCHS standard (now being generally used internationally) for Indian children, and found such use to be appropriate[11].

Secondly, the weight-for-age classification discussed above combines in one number (weight-for-age) two different types of deficits[12], namely, weight-for-height (weight of the observed child compared with that of the median reference child of the same height) and height-for-age (height of the observed child compared with that of the median reference child of the same age and sex). Waterlow[12] had highlighted this by comparing two malnourished children having the same low weights-for-age, on the one hand, with a 'normal' child with weight-for-age corresponding to the 50th centile of the international NCHS standard, on the other. He pointed out that of the two abnormal children with the same low weight-for-age, one could be 'tall and thin' while the other could be short and perhaps even fat. Clearly, the use of a single index (weight-for-age) for defining malnutrition mixes up different types of deficits. Thus, subjects with a low weight-for-age may either have: low weight-for-height or low height-for-age or a combination of both.

The importance of distinguishing between deficits in weight-for-height and in height-for-age is being increasingly realised. The following names are proposed[2] to describe these two deficits and the processes which cause them, as they are purely descriptive of what is observed, without offering answers about cause[11]: *Wasting* for deficit in weight-for-height; and *stunting* for deficit in height-for-age. Underweight (weight-for-age) is, therefore, a composite measure of stunting (height-for-age) and wasting (weight-for-height).

CUT-OFF POINTS

A summary of the terminology and cut-off points (indicators) in relation to the three basic indices related to weight and/or height is provided in Table 1. Three possible statistical approaches can be utilised to distinguish 'well nourished' and 'malnourished' children, namely, percentiles, percentages of the median (IAP approach) and standard deviation or 'Z' scores.

The percentiles are of limited practical utility in developing countries as a vast number of children fall below the lowest percentile (third) and the numbers at extreme degrees of risk cannot be quantified since percentiles below the third are generally not available. The traditional approach to overcome the latter limitation was to use the 'percentage of medians' approach. This technique is known to many health workers in the Third World and it only requires a simple calculation. However, this method does not take into account the variability in the relative width of the distributions[2]. A given per cent of median for an index is not constant across ages and does not have the same meaning for different indices. The suggested cut-off points for defining undernutrition, therefore, vary with the index under consideration (Table 1), being 80 per cent for weight-for-height and weight-for-age and 90 per cent for height-for-age.

Standard deviation or 'Z' scores also allow extrapolation below the lowest percentile by presenting the variation of the anthropometric measurement from the reference median in terms of standard deviations or 'Z' scores[2]. Anthropometric indicators expressed in this manner have distinct statistical advantages since these reflect the reference distribution and are comparable across ages and across indicators.[4] The same cut-off point of -2SD can, therefore, be utilised for all indices (Table 1). The advantage of utilising SD/'Z' scores in the depiction of data is well established; all the three indices can be comprehensively shown in one graph.

However, as a predictor of increased mortality or morbidity, the 'Z' score approach does not have any special advantage over the 'percentage of median' approach of the IAP[14]. Further, in the absence of a computer programme, the 'Z' score approach would require tedious calculations and many health workers are not familiar with this concept.

VARIATIONS IN ESTIMATE WITH CHOICE OF CUT-OFFS

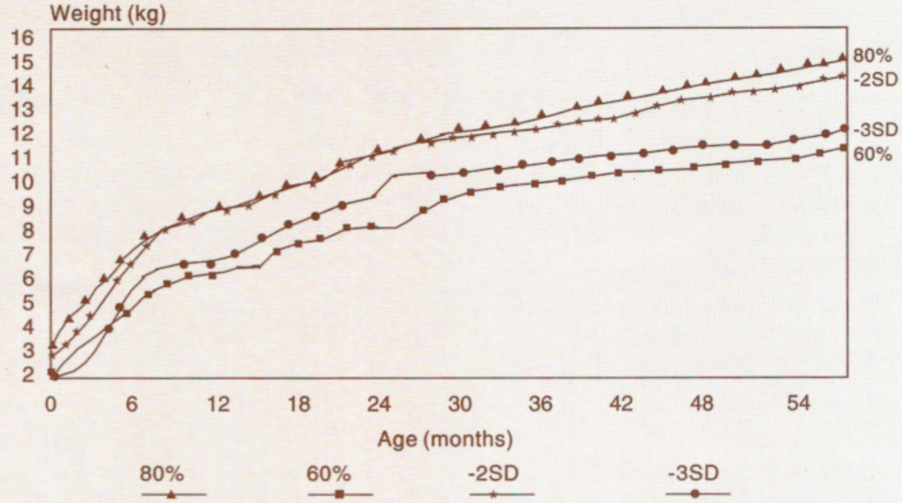
The earlier surveys from the NNMB[3,4] had projected the prevalence of malnutrition with cut-offs based on the 'percentage of median' approach

Table 1: Cut-off points in relation to reference median

Indices		Percentile	IAP	Z or SD
Weight-for-height	Wasting	3rd	<80%	<-2SD
Height-for-age	Stunting	<3rd	<90%	<-2SD
Weight-for-age	Underweight	<3rd	<80%	<-2SD

'Mild malnutrition': between 80% and 70% (IAP system)
'Moderate Malnutrition': between -2SD and -3SD (Z score system) or 70% and 60% (IAP system)
'Severe malnutrition': <-3SD (Z score system) or <60% (IAP system)

Figure 1: Comparison of cut-off values (weight-for-age in under-five boys)



Comparison of actual cut-off values of weight-for-age in boys using NCHS reference standard for the two approaches for identifying 'malnourished' (80% of median versus <-2SD) and 'severely malnourished' (60% of median versus <-3SD).

(IAP) whereas the NFHS[6] had used the SD/'Z' scores. Estimates of undernutrition derived from the use of these two different indices are found to vary given the same order of undernutrition in the populations. This fact has to be clearly recognised in order to avoid misinterpretation.

The magnitude of difference in estimates of undernutrition using these two different indices has been investigated by the author. Figure 1 compares the actual cut-off values of weight-for-age in boys on the basis of the NCHS reference population (median) for the two approaches for identifying 'malnourished' (<80 per cent versus <-2SD) and 'severely malnourished' (<60 per cent versus -3SD) under-five children. The weight-for-age index is used for illustration since it was employed in surveys from both sources.

It will be seen from the figure that quite a number of children who would have been classified as 'moderately malnourished' as per the earlier Gomez and IAP classifications would be included under the category of 'severely malnourished' if the 'Z' score (<-3SD) is used as the yardstick. Thus, estimates of 'severe malnutrition' using the latter system will always be higher than those obtained with the use of the earlier methods of categorisation.

As the next step in our present exercise, the general direction and magnitude of these variations in projections of malnutrition were analysed from actual data. Anthropometric data for 1,218 under-five children were available from one community. Table 2 compares the estimates of malnutrition in this group of children based on these two approaches. Since the earlier surveys[3,4] had reported data on only one- to five-year-old children, two sets of analyses were conducted (zero to five years and one to five years).

The estimates of the total number of malnourished children of all grades based on weight-for-age were marginally higher with the IAP approach than with the standard deviation or the 'Z' score approach. However, the estimates for 'severe' malnutrition based on weight-for-age were consistently significantly higher with the SD/'Z' score approach than with the earlier 'percentage of median' approach of Gomez and the IAP. Thus, as was pointed out earlier, given the same order of undernutrition, the use of the 'Z' score approach would result in a significantly higher estimate of severe undernutrition than what would be obtained with the conventional 'percentage of median' approach that has been in general use earlier. It is clear then that simple comparisons based on these two approaches can easily result in erroneous conclusions and wrong inferences.

OTHER FACTORS

Besides the choice of cut-off points, several other sampling and non-sampling factors, listed in Table 3, can potentially influence the estimates of malnutrition prevalence from surveys. It is possible that the effect of these items may be marginal and some of them could be acting in opposite directions with an unremarkable net influence. Conversely, the conjoint effect may be substantial. It is, therefore, important to be aware of and to adjust for these potential biases before making any valid comparisons.

Recently, instead of the conventional cut-off point, the use of a cut-off curve has been suggested[16]. Estimates of prevalences based on this approach are substantially higher than those obtained by using a cut-off point of -2SD because of the inclusion of 'false negatives' (children outside the reference curve but above the cut-off point). Theoretically, this concept is statistically more robust but the practical application needs validation.

GUIDE FOR INTERVENTION

An objection to the use of cut-off points outlined in Table 1 is that at best they represent purely statistical separation of the 'malnourished' from the 'normal'[2]. Ideally, the cut-off should represent the dividing line between those who need intervention and those who do not[17] and these could be based on biological considerations, such as increased risk of mortality or of functional impairment[2].

Most of the work in this context has been in relation to mortality, an easily identifiable outcome. In a recent meta analysis of the available community studies[18], it was concluded that young children (six to 60 months of age) with mild to moderate malnutrition (60-80 per cent of the median weight-for-age of the reference population) had 2.2 times the risk of dying during the follow-up period than their better nourished counterparts (>80 per cent of the median reference weight-for-age). Severely malnourished young children (<60 per cent of the median reference weight-for-age) had 6.8 times the risk of dying during the follow-up period than better nourished peers. On the basis of these relative risks, it was projected that nearly 41 per cent of the total deaths in this age group are associated with malnutrition. It is noteworthy that more than three-quarters on the percentage of median (IAP) approach and for the latter on Z scores. Ignorance about the finer details of definition and comparability can easily lead to baseless fears of deterioration in the prevalence of 'severe malnutrition'.

The original NNMB data bases[3,4] will have to be reanalysed for comparability with the NFHS data[6] since estimates of malnutrition from the former source have used different approaches and are presented for the age group one to five years instead of zero to five years. It is gathered that NNMB has already undertaken such analysis to facilitate comparisons of the earlier NNMB data with the more recent NFHS data. Even so, caution would be necessary in the interpretation of the results of such comparisons since the sampling design and the age and sex compositions of the two samples may be dissimilar.

CONCLUDING COMMENT

The impression created by some of the reports that 'severe malnutrition' in children in India has increased in recent years is totally erroneous and unwarranted. Surveys, including the latest conducted by NFHS[6], do not by any means justify such a conclusion. Indeed a careful scrutiny of all available data will show that whichever criterion is used, there has been a significant decline in the prevalence of severe forms of malnutrition in children in India in recent years.

In order to avoid confusion of this kind, it will be prudent to restrict the use of the term 'severe malnutrition' to refer to children with weight-for-age <60 per cent of the standard as has been the practice in the past. Children with weight-for-age <-3SD of standard could be referred to as being in Grade II malnutrition of the 'Z' score scale (Grade I of the 'Z' score scale being weight-for-age between <-2SD and <-3SD).

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NUTRITION NEWS

ASIAN NUTRITION FORUM

Some Asian nutrition scientists with long years of first-hand experience in promotion of nutrition science and nutritional programmes in their respective countries have decided to come together to form the nucleus of an informal Asian Nutrition Forum (ANF). The members are in the Forum purely in their individual capacities. They will therefore be free to express their personal views on any topic of collective interest and importance for the nutritional upliftment of Asian peoples without committing their governments and institutions.

It is considered important that Asian nutrition scientists interested in the collective nutritional welfare of their peoples come together to ensure that in the highly competitive world of today, the interests of Asian countries and their peoples are protected. ANF will work for the promotion of a policy of self reliance.

The members of the informal ANF will meet from time to time to discuss matters of common interest. The first meeting will take place in Beijing at the time of the Seventh Asian Congress of Nutrition.

The present composition of the nucleus group of ANF is as follows:

China:	Dr Chen Xiaoshu,
	Dr Ge Ke-you
India:	Dr C. Gopalan
	Dr Rajammal Devadas
Indonesia:	Dr Soekirman,
	Dr Kariyadi
Philippines:	Dr Florentino Solon,
	Dr Cecilia A. Florencio
Sri Lanka:	Dr Priyani Soysa
Thailand:	Dr Aree Valyasevi,
	Dr Kraisid Tontisirin

The ANF will have no formal secretariat at this stage. It is, however, agreed that arrangements for periodic meetings, for drawing up of agendas and for circulation of notes and reports among members will be undertaken on behalf of ANF by Dr C. Gopalan.

Vitamin A And Vaccination

C.Gopalan

As part of their attempts to expand the use of the massive vitamin A dose prophylaxis approach as the answer to the problem of vitamin A deficiency, some international bodies have been persuading health agencies of developing countries to resort to massive dose vitamin A administration to infants, simultaneous with their Expanded Programmes of Immunisation (EPI). The health agencies of some developing countries have apparently already adopted and acted on this advice. As per this advice, apart from vitamin A administration alongside measles vaccination, several thousands of infants in developing countries had been administered 25,000 IU of vitamin A at the same time as each of three doses of DPT and polio vaccines in the sixth, 10th and 14th weeks of their infancy and 1,00,000 IU at the time of measles vaccination.

The strategy of riding vitamin A supplementation on immunisation programmes will, no doubt, serve to greatly expand the market for synthetic vitamin A in poor countries, given the vast infrastructure for immunisation programmes and their proven benefits. This will also result in a vastly expanded use of massive doses of vitamin A in infants.

Commenting on this ill-conceived approach, I had sounded the following note of caution in the pages of this *Bulletin*[1]:

"Whether massive vitamin A administration along with vaccination (as an integral part of EPI) is a desirable or permissible procedure from the point of view of immunologic response to vaccination, on the one hand, and of response of serum vitamin A levels in infants following on vitamin A administration, on the other, has not been investigated. A vastly expanded programme of periodic vitamin A administration to infants along with vaccines on the lines now being promoted, in the absence of vital data justifying such an approach and proving its safety, would amount to an unethical clinical drug trial. And all this at a time when keratomalacia, as a public-health problem, has declined, and in a situation when plentiful resources for combating vitamin A deficiency are available for developing countries at their own doorsteps."

When these words of caution went unheeded, I had repeated the following warning in a subsequent communication[2]:

"We have reason to be deeply perturbed by the reported attempts to promote the use of massive doses of synthetic vitamin A in infants as an adjunct to the EPI programme. The attempt to 'ride' the massive vitamin A dose approach on EPI is unwise. There is no documented evidence that simultaneous administration of a massive dose of vitamin A along with vaccination does not impair the immune response following vaccination, with respect to all vaccines involved in EPI. Also, since vaccination is, in a sense, pseudo-infection, it is reasonable to expect that the retention of vitamin A given simultaneously with vaccination will be poorer than with vitamin A given alone. If the object is to promote maximal vitamin A retention and not just to capture children, then the time of vaccination is an inappropriate choice for vitamin A administration.

"We certainly should not allow an excellent programme of indisputable value (EPI) to be ruined by a dubious 'fellow traveller'. It will be unwise to do anything which will reduce the acceptability of EPI by the community. Surely there must be more legitimate and less hazardous ways of expanding the market for favoured commercial products. Why pick on the defenceless infants of poor countries for such unethical (mis)adventures ?"

SEMBA *ET AL'S* STUDIES

Contrary to my fears that this warning would also be ignored, it was refreshing to note that Semba *et al*[3] (a team which notably included A. Sommer), at long last, chose to address and investigate this issue. These distinguished scientists can certainly not be accused of any 'bias' against the massive vitamin A dosage approach! They have now come out with the observation that vitamin A given with measles vaccination resulted in substantially lower seroconversion in those infants who had significant levels of maternally acquired measles antibody. Since nearly two-thirds of all infants in their study did carry such maternal antibodies, it had to be concluded that vitamin A administration had, in fact, impaired seroconversion in a majority of infants. The authors also caution that vitamin A administration could have a similar impairing effect on vaccination when given with oral polio vaccine and other live viral vaccines.

Commenting on the above study by Semba *et al* and the ongoing attempts to combine vitamin A administration with vaccinations, Ross[4] also warned that the effect of possible interactions of vitamin A with DPT and polio vaccines must be evaluated before this approach is recommended for general use.

Reaction: In the past, all reports from different parts of the world (such as those of NIN, Hyderabad, the Harvard-Sudan study and quite a few others) which had failed to endorse the claims of beneficial effects of massive doses of vitamin A had been either ignored, derided as being faulty in design and execution, explained away, or subjected to statistical alchemy (so-called 'meta analysis') that helped to 'convert' the negative conclusions of the authors of the original reports into positive affirmations! In line with this well-orchestrated pattern, the present report pointing to the possible deleterious effect of combining vitamin A administration with EPI is also sought to be explained away.

The infants who showed impaired seroconversion following on vitamin A administration in Semba *et al*'s study were six months old. It is being argued that, since in infants of nine months of age (the age at which measles vaccination is recommended) the level of maternal antibody *may be* expected to be less, the impairment of seroconversion *may not* be significant at that age point. But as Ross points out, "the proportion of nine-month-old infants with significant maternal antibody levels may still exceed 30 per cent in some populations". The assumption that the maternal antibody level would have de-

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