Assessment of Growth performance of Children in last fifteen years and Developing new Standard Growth Curves of Children's Nutritional Status for India

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Many studies have been done on child malnutrition relating it to child morbidity, child deaths and manpower and so on. In different researches some standard measures are used to identify the malnourished population. For individual applications in screening high risk children, cut-off points should be locally identified by taking into account: the population-specific prevalence and nature of malnutrition; the cut-off point below which children are shown to respond to specific interventions (de Onis, 2000). In India, rich cross sectional data from three rounds of NFHS are available on anthropometric measures namely height and weight. This can be utilized to develop growth curve for children of India. This will help us in identifying malnourished children with our own Indian standards. The present study is an effort in better way to represent children malnutrition in Indian context.

Objectives:

1. To assess child growth performance in India using different nutritional status classification cut-offs of at three point of time.
2. To develop growth curves for Indian reference using three rounds of NFHS data.
3. To study the prevalence of child malnutrition using the new growth curve.

Reference Population for child growth curve

Anthropometry is an important tool in the epidemiological assessment of the health and nutritional status of populations of children. It can be used also in health program to monitor health and nutritional status of individual children. For both type of evaluation, accurate and valid anthropometric classification is an essential step. Anthropometric values are compared across individual or populations in relation to a set of reference values. The choice of reference population to assess nutritional status has a significant impact on the proportion of children identified as being malnourished and, in turn, important programmatic implications for what to do about it (WHO, 1995).

Much has been written about growth references, but there remain unanswered questions about the many factors that determine human growth and indeed what constitutes "normal" growth. Until 2006 the most commonly used reference population was the U.S. National Centre for Health Statistics (NCHS) standard, which was recommended at that time by the WHO (Dibley *et al.*, 1987). In April 2006, a new international reference population released by WHO. A new WHO growth standard adopts a perspective approach, describing how health children should grow. The new standard is based on children around the world (Brazil, Ghana, India, Norway, Oman and the United States) who are raised in healthy environments, whose mother do not smoke , and who are fed with recommended feeding practices (exclusive breastfeeding for the first 6 months and appropriate complimentary feeding from 6 to 23 months). The WHO growth standards identified child as the normative model for growth and development standards, depicts normal early childhood growth under optimal environmental conditions.

Cut-off point of growth curves

It is a designated limit beyond which a subject is classified according to pre-set condition. Prevalence of malnutrition in a population is described in terms of the percentage of individuals below a specific cut-off, such as certain percentage of mean, or percentile, or standard deviation (S.D.) in terms of z-scores. Once an anthropometric indicator and a reference population have been selected, it is necessary to determine the limits of "normality".

There are three classification systems for comparing a child, or a group of children, to the reference population: Z-scores (standard deviation scores), percentile and percent-of-median. The percent-of-median is

simpler to calculate than a Z-score or percentile. Since the calculation of the percent-of-median ignores the distribution of the reference population around the median, the interpretation of any given percent-of-median value varies across age and height groups. In addition, common cut-offs for percent-of-median are different for three anthropometric indicators (WHO, 1995).

Since the late 1970s WHO recommended using the Z-score system because of its several advantages (Waterlow, 1977). For population based applications, the software version of the NCHS/WHO reference greatly contributed to the wide acceptance of the Z-score concept. Percentage practice often recommends the use of a universal cut-off point, e.g. -2 Z-score, which is very useful for population-based monitoring.

Methodology:

Developing new method

Cross-sectional data from NFHS will be used to develop standards. Children of women, who were not smoking, belonging to high standard of living, will be considered for making standard. Additionally children who are raised in healthy environment, and who are fed with recommended feeding practices will be selected. To avoid outliers, observations falling above +3S.D. and below-3S.D. of the sample median will be excluded prior to construction of standard. Smoothing techniques will be applied to raw data before using it for construction of standards. Curve fitting models will be selected as in WHO study. Cox-Box-power-exponential (BCPE) distribution will be selected for constructing the curves. The BCPE (Rigby et al., 2004) is a flexible distribution that offers the possibility to adjust for kurtosis.

Growth curves for three standard indices of physical growth of nutritional status of children will be developed:

1) weight-for-age 2) weight-for-height 3) height-for-age

Selection of standard reference population for India

Based on the review of the literature following characteristics of reference population has been selected which are given below:

Child factor:

Age of child, birth weight, Birth interval, sex of child, non-twins child and infant feeding practices.

Maternal factor:

Nutritional status of mother, Mother's height and weight (excluding obese and undernourished mothers), Number of children, Non-smoking women.

Household factor:

Standard of living, type of family, Sanitation, Safe drinking water

Analysis:

- Regarding first objective, growth standards of NCHS (1977-1978) is used for trend in growth performance of children at different points of time using cross sectional data by large sample survey (NFHS).
- Data from three rounds National Health and Family Welfare Survey (NFHS) explore that percentage of stunted and underweight children has been somewhat decreased over the period but wasted children are little a bit increased.
- However, percentage of severely malnourished children is not much decreased from NFHS-I to NFHS-II but came down further during NHFS-III at each age.
- Stunting are less in lower ages as compared to elder ages and more female child (percentage below -2SD) has been stunted as age is increasing. About 50 percent children are underweight, 40 percent are stunted and one fifth is wasted (percentage below -2SD).

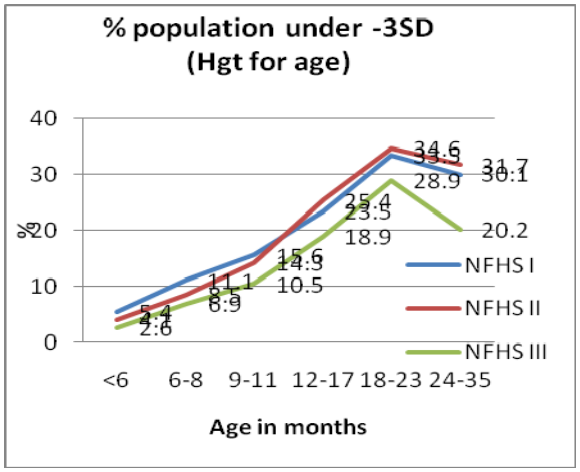
Further study will be carried out for comparison of nutritional level by NCHS classification with WHO growth standard (2006) and a new growth standard will be tried to develop for Indian children using NFHS data. Selection of fitted model (probability distribution) and soothing of curve will be done using appropriate techniques for children under age five (up to age 59 months).

Table 1: Nutritional status of children

Height for age (Stunting)

Age in months	NFHS I		NFHS II		NFHS III	
	% below -3SD	% below -2SD	% below -3SD	% below -2SD	% below -3SD	% below -2SD
<6	5.4	14.9	4.1	15.3	2.6	10.4
6-8	11.1	28.8	8.5	26.6	6.9	21.8
9-11	15.6	35.8	14.3	35.6	10.5	29.8
12-17	23.5	49.5	25.4	52.9	18.9	46.5
18-23	33.5	58.8	34.6	62.3	28.9	57.4
24-35	30.1	55.3	31.7	56.1	20.2	43.5
Total	25.7	48.4	22.8	45.6	19.5	42.6

Note: Children under three are taken because of common to all survey.



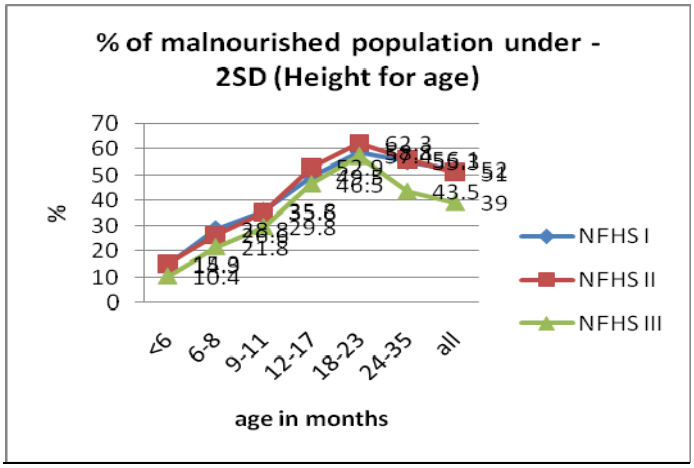


Table 2: Weight for height (Wasting)

age in months	NFHS I		NFHS II		NFHS III	
	% below -3SD	% below -2SD	% below -3SD	% below -2SD	% below -3SD	% below -2SD
<6	1.9	8.6	2	9.7	3.3	10.8
6-8	2.5	12.4	2.2	11	3.2	16.3
9-11	2.8	16.1	3.6	16.5	4.8	22.4
12-17	4.7	24.5	4.1	21.7	4.2	22.9
18-23	5.4	26.1	4.4	22.8	5.3	26.3
24-35	2.7	15.7	2.1	13.9	2.9	17.6
all	3	16	2.9	15.9	3.1	17.3

Table 3: Weight for age (Under weight)

age in months	NFHS I		NFHS II		NFHS III	
	% below -3SD	% below -2SD	% below -3SD	% below -2SD	% below -3SD	% below -2SD
<6	3	13.3	2.1	12.1	2.2	9.9
6-8	10.2	32.9	8.7	29.5	8.3	30.5
9-11	17.1	48.6	15.2	47.5	14.6	45
12-17	24.9	59.3	22.3	57.4	18.1	55
18-23	25	60.7	23.7	59.8	21.5	58.5
24-35	24.6	59.1	24.2	58.6	20.1	55.3
all	19.5	50.4	17.9	47.1	15.4	48.2