Current Practice

The Growth Chart

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My observations at MCH clinics in various parts of the country have indicated that primary health care workers have a poor knowledge of the Child Health and Development Record CHDR (commonly referred to as the Growth Chart) used at these clinics. Their interpretation of the growth curve of a child is faulty. Recently, several parents have consulted me regarding advice given to them by qualified paediatricians based on their child's growth curve. It appears to me that many doctors are ignorant of how the different curves printed on the chart have been derived and how a change in a child's curve should be interpreted. I hope you will be able to spare me sufficient space in your journal to make certain points clear.

Disturbances in health and nutrition, regardless of their aetiology, invariably affect child growth. Therefore, growth assessment is the best way of defining the health and nutritional status of a child. The most commonly used anthropometric index is weight-forage due to the relative ease of measuring weight. Other indices are height-for-age, weight-for-height and mid-upper-arm circumference.

Measurements of weight at monthly intervals are plotted on the chart. A line joining the several points indicates the channel in which the child is growing. To assess the adequacy of growth certain reference lines are printed on the chart. In 1977 the WHO adopted the reference curves published by the National Center for Health Statistics (NCHS). Atlanta, Georgia, USA, for international use1,2. In 1977 there was increasing evidence that the growth patterns of well-fed, healthy pre-school children from diverse ethnic backgrounds are surprisingly similar3. Differences of "genetic" origin are evident for some comparisons; however, these variations are relatively small compared to the large world-wide variation in growth related to health and nutrition4. The red line on the CHDR is the median NCHS for boys and the lower, black line represents the third percentile of the girls in the NCHS population.

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The international reference provides a single set of growth references that permit comparisons of growth data from different populations. However, there are important technical limitations that complicate the interpretation of data from nutrition surveys and surveillance:

1. Two distinct sets of data were used to construct the reference curves. For children under 2 years of age, the data was from the Fels Research Institute in Yellow Springs, Ohio, from studies on a white, middle class population. For older children the data were derived from nationally representative surveys of children in the USA, which included all ethnic groups and social classes[5].

2. The younger children were measured supine (length) while the older children were measured standing (height). For any child the length measurement is always greater than the height measurement. There is a marked discrepancy in estimated height status immediately before and after 24 months, where the two curves merge. Such a disjunction has always shown up in the local nutrition status surveys.

3. The distribution of weight-for-age and weight-for-height are markedly skewed towards the higher end, reflecting a substantial level of childhood obesity, an unhealthy characteristic of the reference sample. Further research on this point is needed, as there is insufficient knowledge of the normality of weight distribution in children of the different ages.

4. The NCHS/WHO curves were derived from studies on bottle-fed infants and may be inappropriate for healthy breast-fed infants. A WHO working group in infant growth[6] found significant differences between growth patterns of infants following WHO feeding recommendations and patterns reflected in the NCHS reference. Infants fed according to current WHO recommendations[7] and living under

conditions that favour the achievement of their genetic potential had a weight for age about 0.5 SD above the NCHS median during the first 3 months, which fell to the median by the 7th month and was about 0.5 SD below the median at the end of the first year. There are risks associated with premature introduction of complementary foods as well as with an undue delay in starting the weaning period[6,8].

A WHO expert committee (1995) reaffirmed the previous WHO position of using a single international reference[9]. However due to significant technical drawbacks on the NCHS growth reference, especially for population based applications, they recommended an update of replacement in the near future. Updating a reference or developing a new one is an extremely complex, costly and time consuming undertaking. There are many inherent difficulties in generating statistically sound and appropriate growth curves. The expert committee has identified some desirable characteristics for data sets when developing a reference population. For a truly international reference, surveys must be conducted in several countries, using standard equipment and well trained personnel.

Generating satisfactory data will take time. Until then, the present Growth Chart will have to continue.

National surveys carried out by the Ministry of Plan Implementation indicate that the mean weight-for-age and height-for-age curves for pre-schoolers in Sri Lanka almost coincide with the third centile of the NCHS reference; that is, half the Sri Lankan children are shorter and weigh less than the lowest 3% of the NCHS population, which is very low standard. A significant number of our children are below the 2nd centile! The 3rd centile is about 2 SD below the NCHS median. Our aim should be to get the mean value to about minus one SD, when a majority of the children will be at or above the 3rd centile.

Is this too high a level for Sri Lanka? In the absence of data on affluent pre-schoolers, one could compare school children from affluent families with the more deprived, to ascertain whether the NCHS median is achievable.

Tables 1 to 4 derived from reference 10, compare the NCHS values with heights and weights of two groups of school children, samples of privileged children attending St. Thomas' College, Mt. Lavinia and St. Bridget's and Holy Family Convents, Colombo, and a sample of less privileged children attending three schools at Kadawatha. Heights of the privileged children approximate the NCHS median at all ages and at age 18 years are within 99% (for boys) and 95% (for girls) of the NCHS values. The Kadawatha children are very close to values that are one SD less than the NCHS median, well above the minus 2 SD, values, which are approximately on the 3rd NCHS centile. These values were obtained by post-graduate students, using equipment recommended by Prof. Tanner, under the direct supervision of their tutor and are the most accurate figures available for Sri Lankan school children[10].

Table 1- *Stature (cm) by age of boys 5-18 years*

Age Yrs	*NCHS Reference Data*			*STC*	*Kadawatha*
	-2 SD	*-1 SD*	*Median*		
5-	103.6	108.4	113.1	111.7	106.7
6-	109.0	114.0	119.1	118.7	113.7
7-	113.9	119.1	124.0	123.5	118.3
8-	118.6	124.1	129.6	127.1	123.3
9-	123.1	128.9	134.8	132.5	126.4
10-	127.6	133.9	140.3	135.1	130.9
11-	132.2	139.3	146.4	141.9	134.2
12-	137.2	145.1	153.0	149.1	139.5
13-	142.8	151.3	159.9	154.7	140.7
14-	149.4	157.8	166.2	159.9	150.1
15-	156.2	163.8	171.5	165.2	163.3
16-	161.5	168.3	175.2	169.2	170.0
17-	163.7	170.2	176.7	170.6	
18-	163.7	170.2	176.7	170.6	

NCHS National Centre for Health Statistics, Washington. STC St. Thomas' College, Mt. Lavinia Kadawatha Three Schools at Kadawatha. -2 SD Two standard deviations below NCHS Median. 5- Between 5 years and 5 years 11 months

Table 2 *Stature (cm) by age of girls 5-18 years*

Age Yrs	*NCHS Reference Data*	*SBC*	*Kadawatha*		
	-2SD	*-1SD*	*Median*		
5-	102.2	106.9	111.6	111.6	105.4
6-	107.2	112.4	117.6	117.0	112.5
7-	112.0	117.7	123.5	122.0	115.7
8-	116.7	123.0	129.3	127.0	120.1
9-	121.8	128.5	135.2	132.9	126.9
10-	127.6	134.6	141.5	138.3	131.3
11-	134.4	141.3	148.2	144.6	137.7
12-	141.1	147.8	154.6	150.1	140.1
13-	145.7	152.4	159.0	153.7	145.6
14-	147.8	154.5	161.2	154.6	149.8
15-	148.7	155.4	162.1	155.2	161.9
16-	149.7	156.2	162.7	156.7	155.4
17-	151.1	157.3	163.4	156.8	155.7
18-	151.8	157.7	163.7	157.0	156.0

NCHS National Centre for Health Statistics, Washington. STC St. Thomas' College, Mt. Lavinia Kadawatha Three Schools at Kadawatha. -2 SD Two standard deviations below NCHS Median. 5- Between 5 years and 5 years 11 months.

Table 3 *Weight (kg) by age of boys 5-18 years*

Weight Kg	*NCHS Reference Data*			*SBC*	*Kadawatha*
	-2 SD	*-1 SD*	*Median*		
5-	15.2	17.4	19.7	18.3	15.5
6-	16.8	19.3	21.7	20.3	16.9
7-	18.4	21.2	24.0	22.6	18.4
8-	19.8	23.2	26.7	24.7	20.3
9-	21.3	25.5	29.7	26.5	22.5
10-	23.1	28.2	33.3	30.3	23.6
11-	25.4	31.4	37.5	34.2	26.8
12-	28.4	35.4	42.3	38.5	28.9
13-	32.5	40.2	47.8	40.7	29.7
14-	37.4	45.6	53.8	44.4	36.6
15-	42.4	51.0	59.5	48.2	39.2
16-	46.8	55.6	64.4	55.6	43.5
17-	49.9	58.9	67.8	54.9	-
18-	50.9	58.9	68.8	55.9	-

NCHS National Centre for Health Statistics, Washington. STC St. Thomas' College, Mt. Lavinia Kadawatha Three Schools at Kadawatha. -2 SD Two standard deviations below NCHS Median. 5- Between 5 years and 5 years 11 months.

Table 4 *Weight (kg) by age of girls 5-15 years*

Weight Kg	*NCHS Reference Data*			*SBC*	*Kadawatha*
	-2 SD	*-1 SD*	*Median*		
5-	14.1	16.5	18.6	17.8	14.7
6-	15.7	18.1	20.6	19.3	17.0
7-	17.1	20.2	23.3	22.1	17.9
8-	18.8	22.7	26.6	24.1	19.0
9-	20.8	25.6	30.5	27.3	21.9
10-	23.1	28.9	34.7	31.1	24.8
11-	25.9	32.6	39.2	35.0	28.7
12-	29.1	36.5	43.8	39.8	30.6
13-	32.5	40.4	48.3	44.2	33.6
14-	35.9	44.0	52.1	45.9	38.1
15-	38.7	46.8	55.0	45.4	40.4
16-	40.7	48.6	56.4	47.1	42.9
17-	41.8	49.3	56.7	47.3	44.9
18-	42.1	49.4	56.6	47.5	43.8

NCHS National Centre for Health Statistics, Washington. STC St. Thomas' College, Mt. Lavinia Kadawatha Three Schools at Kadawatha. -2 SD Two standard deviations below NCHS Median. 5- Between 5 years and 5 years 11 months.

Sri Lankan children perform less satisfactorily where weight is concerned, and weigh much less than the NCHS population at the higher age groups. This is to be expected due to the high prevalence of obesity among the American population. However, the data presented are sufficient to show that the poor performance of the national sample of preschoolers is not due to genetic differences. Both the privileged Sri Lankans and the under- or less-privileged could be assumed to be from the same gene pool. The growth of the privileged could be considered the "attainable growth"[11]. It will therefore be incorrect for us to be satisfied that our preschoolers are at the 3rd centile of the NCHS reference data, when the upper middle class children attain a higher level. Our aim in planning for the future should be to raise the mean value for the whole population to within minus one SD of the NCHS median.

At age 2 years a boy is half his adult height, illustrates the importance of a pre-schooler becoming as tall as his genetic potential allows. It is acknowledged that the work capacity of an adult is proportional to his height.

At birth a child may be below the 3rd centile, between the 3rd centile and the median or above the median. Subsequent weighing will indicate the chance within which the child will grow. If he maintains a channel that is parallel to the red line, his growth could be considered satisfactory. If there is a move away from his channel to a lower one, he needs special attention, to bring him back to his track. The mistake commonly made is to consider a movement to a channel at a higher level also to be unsatisfactory. The mother is accused of overfeeding the child.

A child may be born small for several reasons Once born, he could begin to grow at a faster rate and climb to a channel higher than the one he started in exclusively breast fed children are known to increase from below the NCHS median to about 0.5 SD above the median about the 5th month provided the complementary feeding is adequate. Obesity should be of concern only if he keeps moving up to higher channels with every succeeding month

Some advocate considering a child obese if his weight-for-age is 10% above NCHS. This is not correct. A child could be well above the weight-for-age median if he is tall. Before obesity is considered, his weight-for-height should b assessed.

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