Auxology of Sri Lankan children, age 5 to 18 years. 4. Is there a need for local standards ?

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Summary

The advisability of using a local standard of reference for determining the prevalence of undernutrition among Sri Lankan school children has been examined. In view of the fact that the weight-for-age (W/A) and height-for-age (H/A) of affluent Sri Lankan children are close to the NCHS median values, and that there has been a marked secular change in heights and weights of Sri Lankan children during the past 50 years, especially among the lower socio-economic level households, a change which is probably continuing, it is recommended that the NCHS values continue as standards of reference, and that the NCHS median minus 2 SD values for H/A and W/A continue to be used as cut-off values for determining stunting and undernutrition of children between 5 and 18 years of age. NCHS median minus 1 SD could be used as a desirable value for W/H and NCHS median minus 2 SD as a cut-off point for "wasting" in children below 10 years of age.

Anthropometry is the most widely employed tool in the assessment of nutritional status because the methods are economical, safe, non-invasive and effective when used appropriately. Three main types of anthropometric measurements in common use are length or height, weight and body circumferences.

To ascertain whether a child is growing satisfactorily it is necessary to have a standard of reference. i.e. an objective set of measurements used for comparison. The WHO has recommended the use of charts issued by the National Center for Health Statistics (NCHS), Washington DC (1). An informal international group at the International Congress of Nutrition, 1981, endorsed the WHO's view that the NCHS reference values (2) should be universally used, largely because the numbers in each age and gender-group were large and very full information was available for the three main indicators, – weight for age, height for age and weight for height (3). The NCHS charts are based on the relatively limited and selective data of the Fels Research Institute, collected between 1960 and 1975 from children from birth to 3.0 years. From 3.0 to 18.0 years, however, the data is derived from two specially mounted surveys carried out between 1962/70 and 1971/74 aimed at sampling the whole child population in the USA in a proportional way, i.e. with numbers in each geographical area proportionate to the child population there. The number in each yearly age group varied from 300 to 600 children. The NCHS tables include information on centiles and standard deviations for weight for age (W/A), height for age (H/A) and weight for height (W/H).

Waterlow (4) introduced a two-fold classification of wasting (deficit in weight-for-height) and stunting (deficit in height-for-age), and proposed cut-off points of 80% of the NCHS median for wasting, and 90% of median height-for-age for stunting. These cut-off points were chosen as being approximately 2 SD below the median. The criterion is a statistical one. Anyone outside -2 SD of the reference median is potentially "abnormal". Mortality has been shown to be related to deficit in weight-for-age,

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weight-for-height and height-for-age, among pre-school children (5). Between 6 and 18 years this relationship is not so clear. In a follow-up study, several children of school age under the third percentile for weight and height had reduced levels of serum albumin, which would put them in an "at risk" category (6).

In place of percentiles and percentages, the standard deviation from the reference median is now expressed as z.-scores (7). The z-score technique circumvents problems associated with the use of percent values of the median, as cut-off points (8). The z-scores will always have a normal distribution. The probability of a z-score taking a particular value can be calculated (7).

The use of reference data from developed countries in developing countries has been questioned on the grounds that

1. the genetic potential in all populations need not necessarily be the same.

2. the physical growth attained by populations in technologically advanced countries should not be taken as ideal.

It has therefore been suggested that, where the "attainable growth" of a population differs from international reference values, local standards should be used (9). The use of several growth charts, representing the different socio-economic groups in a country, has also been advocated (10).

Proponents of a single international standard argue that

1. young children of different ethnic groups have essentially the same growth potential (11). If they do not achieve that potential, it is because growth is depressed by environmental factors, which may be related to food as well as non-food factors.

2. differences in height and weight among well-nourished children in different ethnic groups are relatively small, in contrast to differences between children of different social classes of the same ethnic group (12).

3. when selecting samples for local standards it is difficult to ensure that samples of adequately nourished subjects drawn from less-developed nations do not include significant proportions of chronically undernourished individuals, because there is no constantly reliable method of defining the ill-nourished.

4. for drawing up standards, large, representative, well-described samples have to be studied, using standard techniques, and the cost and labour involved is very great. The economic resources available to those in industrialized countries who generate reference data are usually abundant. Consequently, samples are large, representative, well-described, and age trends are smoothed using sophisticated techniques. Therefore, international standards are highly dependable.

5. the "attainable growth" of a population will vary with conditions, and secular changes will necessitate a constant revision of the local standard, as socio-economic and educational standards improve or deteriorate.

6. apart from the difficulty of drawing up local references for different socio-economic groups, there is also the practical one facing primary health workers when using several sets of charts in a clinic.

The question has been raised as to whether Sri Lanka should continue to use the NCHS tables as reference values, or whether tables and charts drawn up using values obtained from Sri Lankan children should be preferred. Lucas *et al.* (13) have constructed centile charts which they recommended for use in monitoring Sri Lankan school-age children. In this paper this question will be reviewed in the light of data obtained from surveys carried out during the past 5 decades.

The Sri Lankan situation

The earliest study on heights and weights of school children was that reported in 1936 by Nicholls (14). The height-distance curve (illustrating the change of height with age) for affluent children attending Royal College (RC) Colombo was at a higher level than the curves for children in other senior secondary schools (SS) and for children of a low socio-economic level attending vernacular schools (VS). The boys at RC were taller than British boys of that decade. The British curve started well below all Ceylonese curves at age 5 y, overtook the VS boys between 6 and 7 y, was almost alongside the SS curve till age 15 y. The final height achieved by British boys and the RC boys was the same. Similarly for girls. The British height distance curve was below the Ceylonese curves at age 5 y, caught up with the VS girls at age 9 y and went above the SS curve at age 13 y.

The weight-distance curve (showing the change in body weight with age) for British children, on the other hand, were well above the Ceylonese curves, at all ages, except between 13 and 16 y when the RC boys were heavier.

After a more extensive survey in 1948/49, Cullumbine (15, 16) prepared a grid of the Wetzel pattern, for appraisal of growth and development of Ceylonese children.

Gunasekara and Mahadeva (1957) studied school children in the Western Province (excluding Negombo). Their sample represented a true cross-section of children from all communities and socio-economic levels (17). The values obtained were converted to age-height-weight tables for boys and girls. No comparison was made with international values.

In 1984/85 Lucas *et al.* (13) measured heights and weights of a heterogeneous population of school children and constructed centile charts. Their survey did not, however, satisfy the requirements laid down by the WHO for drawing up local standards (1).

Values obtained by Gunasekara and Mahadeva and by Lucas *et al.* were from mixed populations and do not give an idea of the "attainable growth" of Sri Lankan children. In a country like Sri Lanka, where a large number of children are subject to general undernutrition, standards should not be based on a random sample of the entire population. Rather, they should be based on a sample of the population that is environmentally faring the best, since such individuals represent the currently available range of desired norms for the entire population of the country.

In 1989 Amarasinghe and Wikramanayake (18) reported studies on 8610 children, representing the affluent (boys attending S. Thomas' College, Mt. Lavinia and Kollupitiya, and girls attending S. Bridget's and Holy Family Convents, Colombo) and those of lower socio-economic educational status households, attending schools in Kadawatha about 10 km north-east of Colombo. Differences in heights and weights of the two major ethnic groups, the Sinhalese and the Sri Lankan Tamils, were not significant. There were marked differences due to varying socio-economic-educational levels, especially in the preadolescent group (age 5 to 10 y). Comparison with curves published by Nicholls showed that there has been a marked secular change in heights and weights during a period of 50 years, the increase being more marked among the lower socio-economic groups than among the affluent.

Comparison with the NCHS median showed the affluent Sri Lankan children to be taller than the NCHS population till age 7 y for boys and age 6 y for girls. Thereafter the curves diverged, the NCHS population being taller. The mean weights of Sri Lankan children were well below the NCHS median. Affluent boys attained 96.5% of the NCHS median for height at age 18 y, and affluent girls 96.0%. At 18 y the boys had attained 81.1% and the girls 83.4% of the median weight of the NCHS population.

In Fig. 1 the height distance-curves described by Nicholls in 1936 for secondary school girls (SS), by Cullumbine in 1950 for the general female population ages 10 to 18 years (15), and by

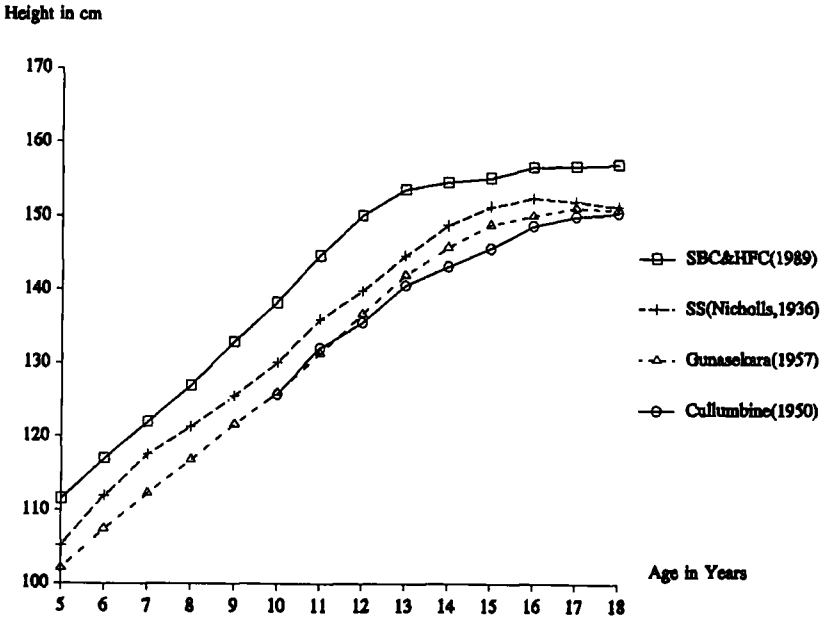

Fig. 1. Height – distance curves of Sri Lankan girls.

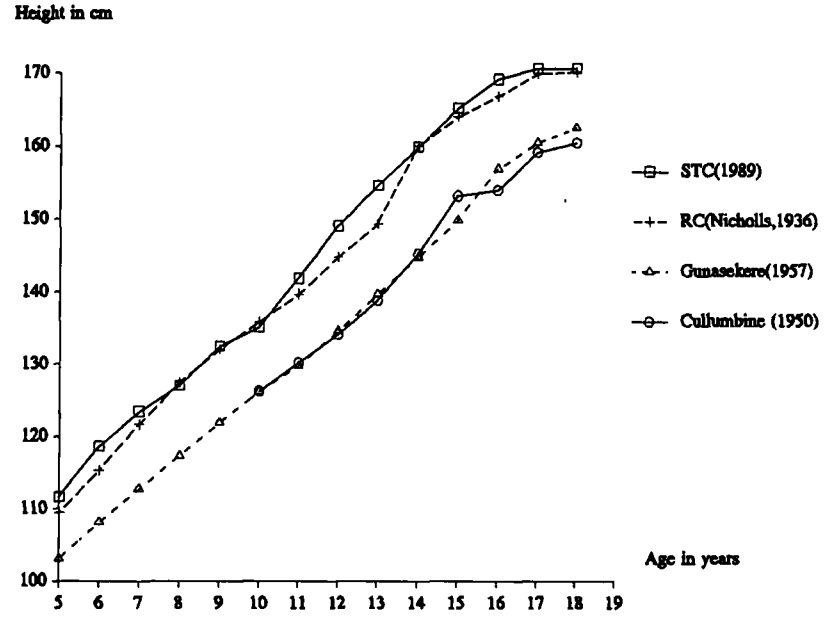

Fig. 2. Height – distance curves of Sri Lankan boys.

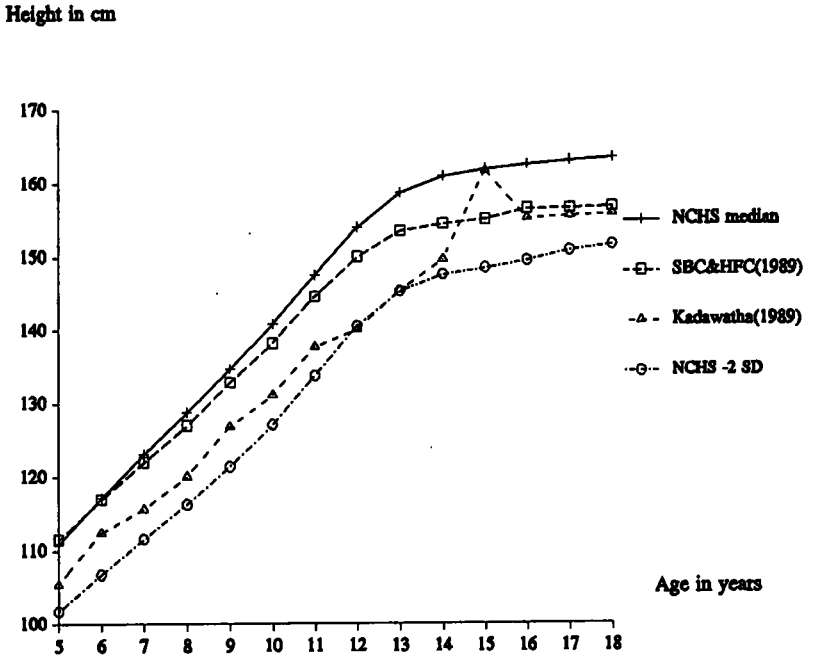

Fig. 3. Comparison of Sri Lankan height – distance curves with NCHS median and -2 SD curves (girls).

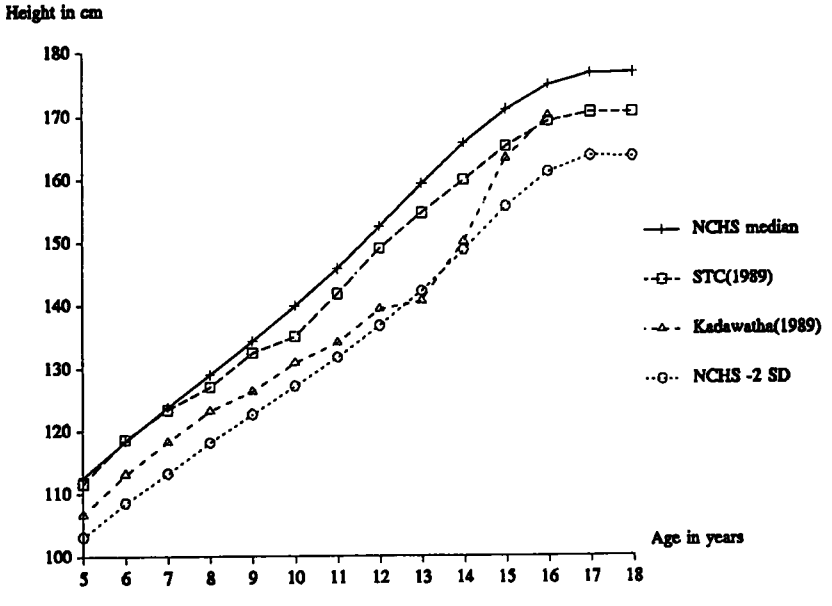

Fig. 4. Comparison of Sri Lankan height – distance curves with NCHS median and -2 SD curves (boys).

Gunasekara and Mahadeva in 1957 are compared with the curve published in 1989 for affluent girls in Colombo. Clearly, values obtained from a mixed population of girls drawn from households of all socio-economic-educational levels do not indicate the attainable heights of Sri Lankan girls.

Fig. 2 shows the corresponding height-distance curves for boys. Again, the curve for affluent boys is well above those representing mixed populations.

Therefore, the heights of children drawn from affluent households may be taken as representing the "attainable heights" for Sri Lankan children. How do these compare with the NCHS reference values ?

Figs. 3 and 4 show the height-distance curves for the affluent (SBC + HFC, STC), the curves for children of a lower socio-economic level at Kadawatha and the median and -2 SD curves of the NCHS population. The attainable heights of Sri Lankan children are between these two NCHS curves. The Kadawatha curves are slightly above the -2 SD NCHS curves, which are almost the same as the 3rd centile curves. It appears therefore that the NCHS median curves for height could continue as a reference standard for Sri Lankans. Children whose heights are below the -2 SD NCHS curve could continue to be categorized as being "stunted".

Figs. 5 and 6 compare the weight-distance curves of affluent children of 1989 with those at Kadawatha (1989) and curves obtained earlier for mixed populations of school children. As in the case of heights, the weights of affluent children are more representative of the "attainable weights" than those of a more mixed population. Figs. 7 and 8 show that the weight-distance curve of affluent children lie between the NCHS median and -1 SD curves, and the -2 SD curve from the median could be used as a cut-off level for determining whether a child has a low weight-for-age.

Taking the NCHS median as the reference height for age, all children from the affluent groups studied in 1989 having that height have been grouped together and their mean weight estimated. This mean value would represent the weight-for-height of this population.

Figs. 9 and 10 compare the weight-for-height curves thus obtained for affluent Sri Lankan children with the NCHS curves. The curve for affluent girls (SBC & HFC in Fig. 9) is below the NCHS median and closer to the NCHS -1 SD curve. For boys also (STC in Fig. 10) the weight-for-height curve lies between the NCHS median and -1 SD curves. The mean height of boys 5 yr old was 111.7 cm. Those with heights less than this value are seen to be below the -2 SD NCHS weight-for-height curves. Similarly girls shorter than 111.6 cm. (mean height of 5 yr old girls) have low weights-for-height. Thus, even in the affluent population studied there have been some who were undernourished.

Recommendations

Studies conducted in Sri Lanka during the past 50 years indicate that

1. In agreement with results reported by Mora (12) differences in height between Sri Lankan children of different social classes are greater than the differences between Sri Lankan affluent children and the NCHS reference values.

2. NCHS median curve for height is not too high a reference value for Sri Lankan children, and a value below -2 SD of the NCHS median value could continue to be used to differentiate the stunted from others.

3. The weight – distance curves for affluent Sri Lankan children are as far removed from curves for the less privileged as from the NCHS median and almost coincides with the -1 SD NCHS curve. It is possible that the NCHS median values may be distorted by the presence of unknown proportions of obese individuals in the USA population studied. If this be so, the use of such a standard would tend to overestimate the true

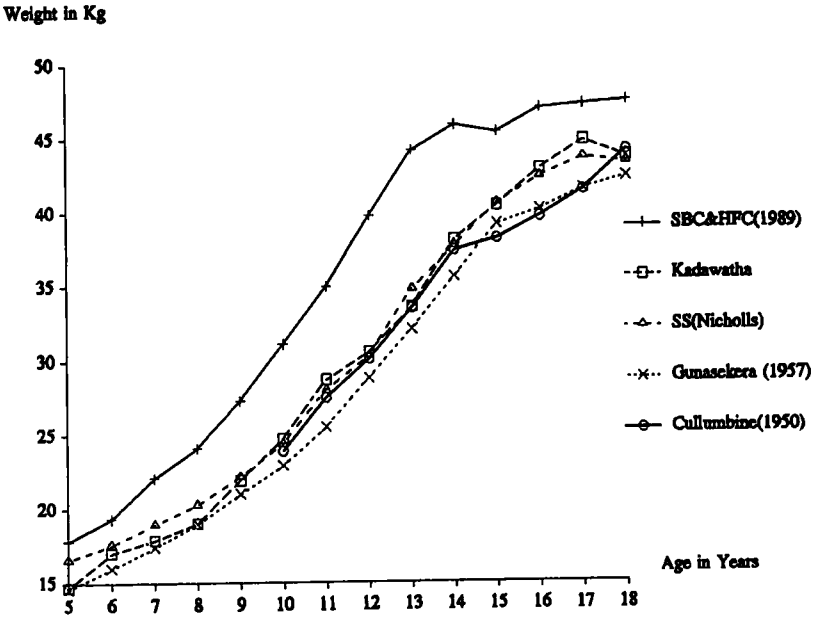

Fig. 5. Weight – distance curves of Sri Lankan girls.

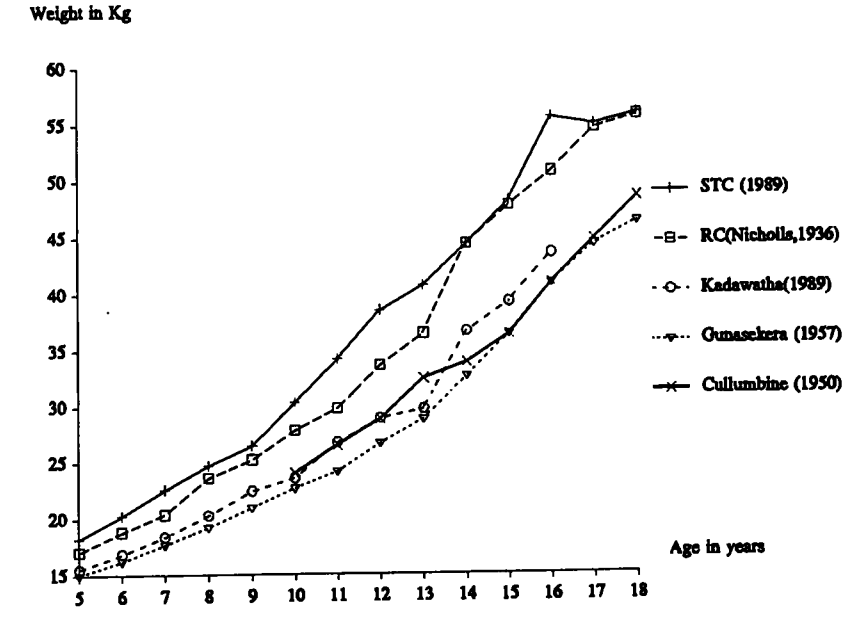

Fig. 6. Weight – distance curves of Sri Lankan boys.

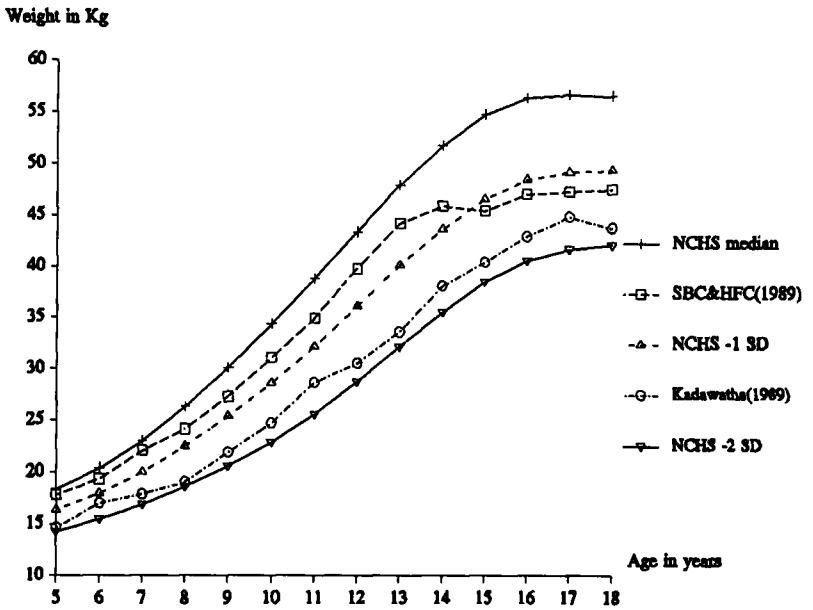

Fig. 7. Comparison of Sri Lankan weight – distance curves with NCHS median, -1 SD and -2 SD curves (girls).

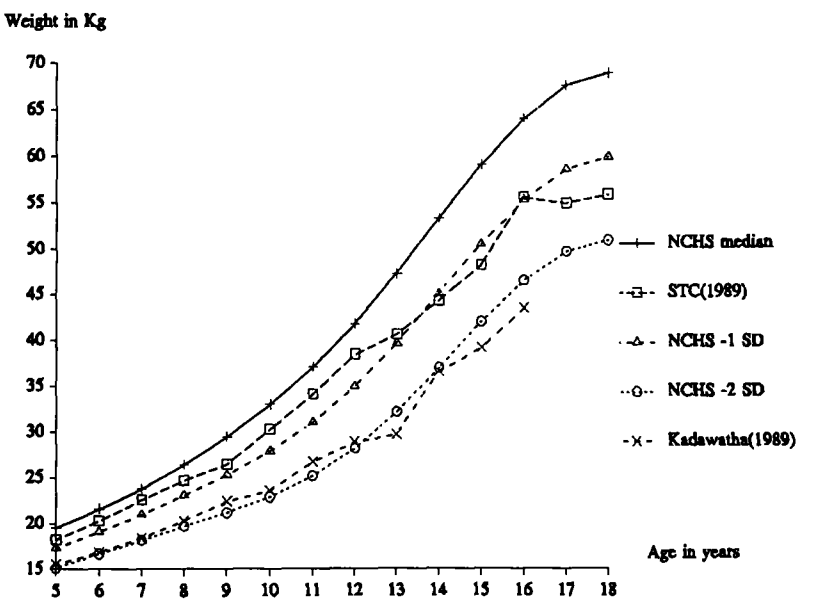

Fig. 8. Comparison of Sri Lankan weight – distance curves with NCHS median, -1 SD and -2 SD curves (boys).

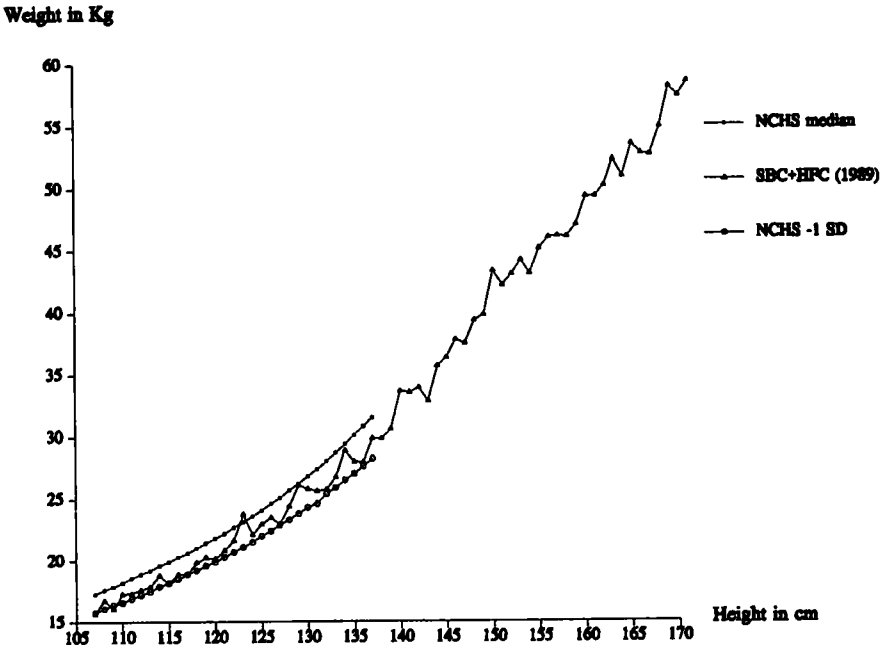

Fig. 9. Comparison of weight-for-height curve of affluent Sri Lankan girls with NCHS median and -1 SD curves.

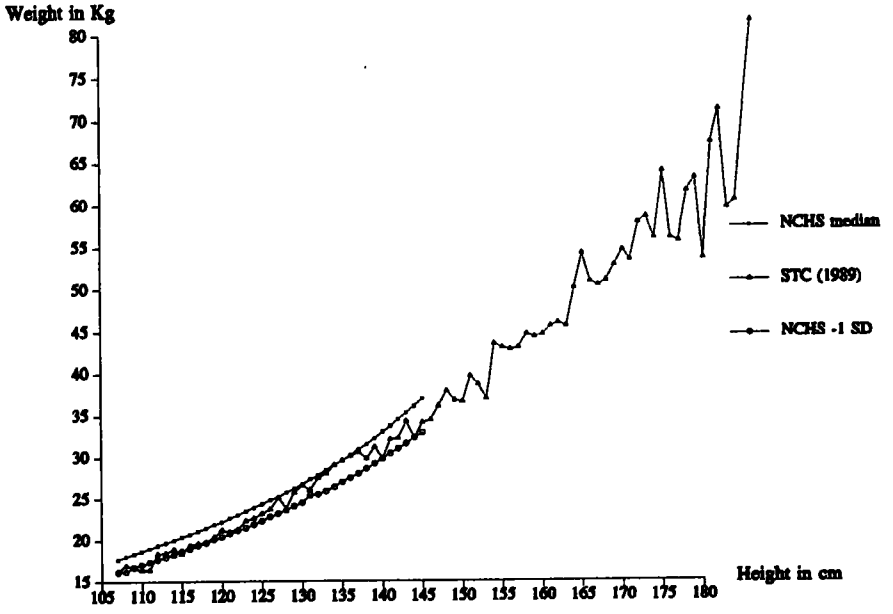

Fig. 10. Comparison of weight-for-height curve of affluent Sri Lankan boys with NCHS median and -1 SD curves.

prevalence of "under-weight" children in Sri Lanka. The choice therefore is between the -1 SD NCHS curve and the median. Because there has been a positive secular change in both the height-distance and the weight-distance curves of affluent Sri Lankans since 1936, and the change is probably continuing, it is recommended that the NCHS median be used for reference. This will enable comparisons to be made with results obtained in other countries. It will also show any changes that occur due to changes in the socio-economic-educational levels of the population, and the effect, if any, of intervention strategies. The -2 SD curve could be used as a cut-off level. The aim of intervention programmes should be that of bringing the entire population above the -2 SD curve for height and weight.

4. The numbers of affluent children in each "height group" are insufficient for arriving at decisions regarding weight-for-height reference values for Sri Lankans. The NCHS tables do not give weight-for-height values above a height of 145 cm for boys and 137 cm for girls, and the WHO do not recommend the use of the NCHS weight for height values for those above 10 years of age. The -1 SD value could be taken as the "desirable" or "attainable" value and the -2 SD value could be used as a criterion of "wasting" in pre-adolescent children.

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