

APPLICABILITY OF NCHS HEIGHT-FOR-AGE AND WEIGHT-FOR-AGE REFERENCE VALUES TO SRI LANKAN SCHOOL CHILDREN

by

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SUMMARY. Heights-for-age and weights-for -age of children drawn from the upper socio-economic-educational households in Sri Lanka have been compared with the corresponding NCHS reference values.

Results indicate that the NCHS height-for-age reference values for children between 5 and 9 years of age are "attainable" by Sri Lankan children, except at centiles above the 75th. The NCHS weight-for-age reference values are well above the corresponding values for Sri Lankan children between 10 and 18 years of age. Between 5 and 9 years of age, Sri Lankan girls are significantly lighter than the NCHS population. There is no significant difference between weights of boys, 5 to 9 years, in the two populations.

The advisability of using NCHS reference values for weight-for-height for assessing the degree of "wasting" in Sri Lankan children is questioned.

INTRODUCTION

The WHO has recommended the international use of reference values for heights and weights of children compiled by the National Center for Health Statistics (NCHS) of the USA, and has laid down guidelines for the measurement of nutritional impact on children (1). The NCHS reference data are a result of several years of work and combine two reference populations, both of which were large and randomly selected from different economic and ethnic groups in the USA.

A lively debate has been going on over the merits of such a single, international set of reference values versus those of a local standard. It is argued that values drawn from large industrialised nations are not applicable to samples drawn from the third world populations, because even the well-to-do groups of some developing countries grow well below the Western reference populations (2). The suggestion is that the growth of such well-to-do groups be viewed as the "attainable growth" of these populations (2).

Proponents of a single standard argue that young children of different ethnic groups have essentially the same growth potential. If they do not achieve that potential, it is because growth is depressed by environmental factors such as malnutrition (3). Differences of weight and height 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 (4, 5). When selecting samples for local standards it is difficult to ensure that samples of adequately nourished subjects drawn from less-developed nations do not contain significant proportions of chronically undernourished individuals,

because there is no constantly reliable method of defining the ill-nourished (6). Further, for drawing up local standards, large representative and well-described samples have to be studied, using standard techniques, and the cost and labour involved in such an exercise will be very great (7). Another drawback is that the "attainable growth" might vary with conditions, and local standards will have to be constantly revised as socio-economic standards within a particular group improve or deteriorate.

There is no readily available solution to this disagreement.

Nicholls (8) found that boys attending Royal College, Colombo in 1936 had a height-distance curve that was almost identical with that of British boys. At that time boys attending Royal College were drawn from the very high socio-economic-educational status households. Their anthropometric data could be taken as indicating the "attainable growth" for Sri Lankan boys of that decade.

The aim of the present study was to test the hypothesis that the heights-for-age and weights-for-age of boys and girls from high socio-economic households in Sri Lanka are similar to the NCHS reference values. Two schools, S. Thomas' College, Mt. Lavinia (STC) and S. Bridget's Convent, Colombo (SBC) were selected for this purpose. It was assumed that all children attending these two schools were of similar socio-economic status. No attempt was made to exclude those of a lower socio-economic status who were assisted with bursaries and scholarships.

MATERIALS AND METHODS

All children attending school on the day of the interview were included in the study, a very few with obvious physical defects being excluded. Their dates of birth were obtained from the class register and the age computed to the year of interview (namely, 1988).

Height was measured using a Holtain portable stadiometer measuring up to 2 m with an accuracy of 0.1 cm. The child was measured barefooted, standing up straight with head in the Frankfurt plane, and gentle upward pressure was applied under the mastoid processes by the measurer after the head-piece had been brought into contact with the occiput.

Weight was measured on a portable platform beam balance (Baumann, Germany) with non-detachable weights, weighing up to 100 kg with an accuracy of 0.1 kg. The balance was checked at each weighing session using lead blocks of known weight.

Both instruments were checked for zero error before commencing each measuring session, and at intervals during the session. All measurements were taken by trained persons who were reading for the degree of M.Sc. Food and Nutrition, under the personal supervision of one of us (T.W.W.). The observers were rotated from time to time to reduce the effect of individual bias (1).

The height-for-age and weight-for-age of each subject was estimated. Using a Lotus 123 statistical computer package arrays of heights-and weights-for age were obtained and values for the 5th, 10th, 25th, 50th, 75th and 95th centiles picked out as the raw data. This data was "smoothed" based on a correlation coefficient between 0.99 and 0.96. These centiles for heights and weights were compared with the corresponding NCHS values.

Regression lines were drawn for the 25th, 50th and 75th centiles of heights-for-age and weights-for-age for Sri Lankan children and the NCHS population. The two regression lines were compared. Where the computed values for variances, gradients and intercepts were less than the tabulated value at 99% confidence level for the 14 observations in each centile, then it was considered that there is no statistically significant difference between Sri Lankan and NCHS populations.

RESULTS

Tables 1, 2, 3 and 4 give the raw data for heights and weights for the children at STC and SBC, and Tables 5, 6, 7 and 8 the smoothed data. Tables 5, 6, 7 and 8 also compare the 5th, 10th, 25th, 50th, 75th 90th and 95th centiles of heights-for-age of Sri Lankan children (smoothed data) with those of the NCHS population. In Table 9 are the computed values for variances, gradients and intercepts obtained in the comparison of the regression lines of Sri Lankan children with the NCHS reference population, for height-for-age and weight-for-age. The correlation coefficient for both populations is 0.99 for all the centiles of heights and weights. The tabulated values were :

variances 4.16, gradients 2.48 and intercepts 2.48.

Height-for-age

The 25th centile lines for both populations coincide in age groups 5 to 9 for both males and females (Tables 5 and 6). The NCHS values are slightly higher than the Sri Lankan values thereafter, and reach a plateau between 17 and 18 years. On the other hand, the Sri Lankan males are still growing at 18 years, though shorter than the NCHS males at that age. The Sri Lankan females reach a height at 17 and 18 years greater than the NCHS females and appear to be still growing at 18 years.

Similarly, the 50th centiles for both males and females in the two populations coincide between ages 5 to 10. The NCHS values are higher thereafter and reach a plateau between 17 and 18 years. Sri Lankan males and females have overtaken the NCHS population by the age of 17 and are continuing to grow at 18 years.

The 75th centiles for the two populations coincide between 5 and 10 years and diverge thereafter, NCHS values remaining at a higher level than the Sri Lankan values.

There is no statistically significant difference between the two populations when the 25th and the 50th centiles for height—for—age are considered (Table 9), whereas the 75th centile values are marginally different, the NCHS values being slightly higher.

TABLE 1. Height for age of males, 5—18 years at S. Thomas' College, Mt. Lavinia. (raw data)

Age yrs.	N	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th percentile
05—	93	101.9	103.9	107.6	111.5	114.7	117.8	119.4
06—	96	109.4	111.2	114.5	118.3	122.9	127.1	129.0
07—	93	116.4	117.2	120.2	124.5	128.0	132.0	134.0
08—	99	118.6	120.2	123.8	128.0	131.7	136.7	137.9
09—	96	121.9	122.1	126.0	130.3	132.9	136.3	139.2
10—	99	127.7	130.3	133.4	137.8	142.1	143.5	146.1
11—	98	130.1	134.6	138.9	144.0	148.1	150.8	153.7
12—	99	135.7	137.7	142.7	147.5	153.4	161.6	163.7
13—	103	136.8	139.8	147.4	155.1	159.4	165.2	167.7
14—	104	145.2	147.3	151.9	159.9	165.4	168.9	171.9
15—	95	150.7	155.5	157.1	160.9	167.9	171.5	173.7
16—	102	159.6	162.9	161.9	175.9	172.1	174.5	177.1
17—	106	160.4	166.4	164.7	174.8	175.5	178.2	179.6
18—	94	162.7	169.0	165.2	177.5	171.9	176.3	178.0

TABLE 2. Height for age of females, 5 — 18 years at S. Bridgets' Convent, Colombo (raw data)

Age yrs.	N	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th percentile
05—	84	102.9	103.5	107.6	111.4	114.2	118.5	119.5
06—	89	109.8	110.5	112.9	116.3	119.0	122.8	124.0
07—	93	112.8	115.1	118.4	122.5	126.4	129.4	131.3
08—	87	117.7	119.6	123.7	127.9	132.2	135.1	145.0
09—	91	123.0	125.2	130.4	134.5	139.3	143.4	150.6
10—	84	128.2	130.2	133.6	139.8	144.1	148.4	152.4
11—	87	132.1	134.9	135.6	144.7	148.1	150.8	158.4
12—	105	132.4	139.2	139.6	150.6	154.5	157.0	152.6
13—	86	136.1	140.1	143.5	148.0	156.6	155.7	160.7
14—	102	138.4	141.9	150.8	153.6	157.0	159.2	165.1
15—	94	141.3	147.1	151.0	154.8	162.5	162.7	164.2
16—	80	147.2	149.6	153.2	160.2	163.6	162.9	167.9
17—	84	148.3	151.3	152.8	158.0	162.7	164.7	167.9
18—	96	152.7	156.8	161.4	166.0	173.1	174.3	174.8

TABLE 3. Weight for age of males, 5 — 18 years at S. Thomas' College, Mt. Lavinia (raw data)

Age yrs.	N	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th Percentile
05—	93	14.0	14.6	16.4	17.5	19.4	22.1	23.7
06—	96	16.0	16.4	17.8	19.3	21.2	26.0	28.5
07—	93	18.0	19.1	20.3	22.1	25.0	30.9	32.4
08—	99	19.7	19.9	21.5	23.9	26.1	32.6	35.4
09—	96	19.1	20.0	21.8	24.5	26.1	32.3	35.5
10—	99	22.5	24.0	26.1	28.6	33.4	38.1	39.6
11—	98	24.4	25.8	28.3	33.3	39.8	45.8	50.7
12—	99	25.5	26.7	29.6	34.5	39.0	49.8	59.1
13—	103	26.6	29.5	37.6	40.6	47.8	52.0	53.2
14—	104	27.6	34.2	37.1	44.2	51.2	57.3	61.5
15—	95	31.9	35.2	37.0	43.1	49.8	59.6	70.0
16—	102	35.9	39.0	40.2	47.0	52.3	62.3	70.9
17—	106	42.0	44.5	48.5	51.5	56.7	66.8	71.6
18—	94	44.0	46.0	48.0	52.6	58.3	67.5	79.7

TABLE 4. Weight for age of females, 5 — 10 years, at S. Bridgets' Convent, Colombo (raw data)

Age yrs.	N	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th percentile
05—	84	13.9	14.6	16.1	17.4	19.2	22.1	23.0
06—	89	15.6	16.4	17.5	19.0	20.9	24.0	26.2
07—	93	16.0	16.9	18.7	21.0	25.1	30.5	33.5
08—	87	19.1	20.2	22.4	25.0	28.7	33.8	37.3
09—	91	21.0	22.5	24.7	28.3	29.6	39.4	42.3
10—	84	22.5	23.2	26.6	29.6	34.1	40.9	47.2
11—	87	25.7	27.2	30.1	33.4	38.0	44.5	52.1
12—	105	26.5	28.5	32.1	37.5	43.6	51.9	55.6
13—	86	29.8	32.2	37.6	40.6	47.8	55.7	62.5
14—	102	31.6	32.2	37.8	41.9	47.6	52.0	53.2
15—	94	35.2	35.8	39.9	44.9	49.8	53.9	71.8
16—	80	38.9	40.8	42.9	46.1	50.0	51.8	76.7
17—	84	35.1	38.5	45.5	50.3	50.8	59.8	61.9
18—	96	40.1	42.3	48.0	53.1	59.3	76.0	84.1

Table 5. Comparison of height for age of S. Thomas' College males of 5—18 years with corresponding NCHS reference values (smoothed data)

Age yrs.	5th percentile		10th percentile		25th percentile		50th percentile		75th percentile		90th percentile		95th percentile	
	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS
05—	101.9	*104.9	103.9	106.7	107.6	109.6	111.5	113.1	114.7	116.1	117.8	118.7	119.4	120.3
06—	109.4	110.4	111.2	112.3	114.5	115.3	118.3	119.0	121.1	122.2	127.1	124.9	129.0	126.6
07—	116.4	115.6	117.2	117.6	120.2	120.6	124.5	124.5	126.2	127.8	132.0	130.8	134.0	132.7
08—	118.6	120.3	120.2	122.7	123.8	125.7	128.0	129.6	131.7	133.2	136.7	136.5	137.9	138.8
09—	121.9	125.3	122.1	127.6	126.0	130.8	130.3	134.8	132.9	138.8	136.3	142.4	139.2	144.9
10—	127.7	130.1	130.3	132.6	133.4	136.0	137.8	140.5	142.1	144.6	143.5	148.7	146.1	151.5
11—	130.1	135.0	134.6	137.7	138.9	141.5	144.0	146.4	148.1	151.1	150.8	155.6	153.7	158.5
12—	135.7	140.2	137.7	143.0	142.7	147.4	147.5	153.0	153.4	158.2	161.6	163.2	166.1	167.7
13—	136.8	145.2	139.8	148.7	147.4	153.6	155.1	159.9	159.3	165.3	165.2	170.5	167.7	173.4
14—	145.4	152.0	147.3	151.9	151.9	160.1	159.8	166.9	165.4	169.9	168.9	176.6	171.9	179.5
15—	150.7	158.3	155.5	161.2	157.1	166.2	164.7	175.9	167.9	176.3	171.5	180.8	173.7	183.9
16—	159.6	163.4	161.3	166.1	161.9	170.6	169.6	175.2	172.1	179.5	174.5	183.6	177.1	186.6
17—	160.4	165.3	163.4	168.5	164.7	172.4	174.8	176.7	175.5	181.0	178.2	185.0	179.6	187.6
18—	162.7	165.7	163.0	168.7	165.2	172.3	177.5	176.8	176.9	181.2	176.3	185.3	178.0	187.6

* NCHS values are those for ages 5.5, 6.5 years, etc. except at 18 years when the value at 18.0 years has been taken for comparison.

TABLE 6. Comparison of height for age of S. Bridget's Convent females of 5—18 years with the corresponding NCHS reference values (smoothed data)

Age yrs.	5th percentile		10th percentile		25th percentile		50th percentile		75th percentile		90th percentile		95th percentile	
	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS
05—	102.9	*103.9	103.5	105.6	107.6	108.4	111.4	111.6	114.2	114.8	118.5	117.4	119.5	119.2
06—	109.8	109.2	110.5	110.0	112.9	114.1	116.3	117.6	124.2	121.3	124.8	124.2	125.0	126.1
07—	112.8	114.4	115.1	116.2	118.4	119.5	122.5	123.5	126.4	127.5	129.4	130.9	131.3	132.9
08—	117.7	119.5	119.6	121.3	123.7	124.9	127.9	129.3	132.2	133.6	135.1	137.4	136.5	139.6
09—	123.0	124.8	125.2	126.6	127.6	130.6	134.5	135.2	139.3	139.8	143.4	143.9	140.5	146.2
10—	128.2	130.4	130.2	132.5	133.6	136.7	139.8	141.5	144.1	146.1	144.4	150.4	146.6	152.8
11—	132.1	136.6	134.9	139.0	140.8	143.5	144.7	148.2	148.1	152.6	150.8	156.9	151.6	159.5
12—	132.4	142.7	139.2	145.4	144.7	150.1	149.3	154.6	154.5	158.8	151.3	162.9	152.6	165.9
13—	136.1	147.2	140.1	150.0	144.9	154.7	150.6	159.0	156.6	163.2	155.7	167.3	156.7	170.0
14—	138.4	149.7	141.9	152.5	150.8	156.8	153.6	161.2	157.0	165.6	159.2	169.8	160.9	172.2
15—	141.3	151.1	147.1	153.6	151.0	157.5	156.8	162.7	162.5	166.7	162.7	170.9	165.1	173.1
16—	147.2	152.2	149.6	154.6	153.2	158.2	160.2	162.7	163.6	167.1	162.9	171.2	164.2	173.4
17—	148.3	153.2	151.3	155.6	162.1	159.1	168.1	163.4	172.0	167.5	164.7	171.4	167.9	173.5
18—	152.7	153.6	156.8	159.6	164.2	159.6	170.3	163.7	173.1	167.6	174.3	171.6	174.8	173.6

* NCHS values are those for ages 5.5, 6.5 years etc., except at 18 years when the value for 18.0 years has been taken for comparison.

TABLE 7. Comparison of weight for age of S. Thomas' College males of 5—18 years with the corresponding NCHS reference values (smoothed data)

Age yrs.	5th percentile		10th percentile		25th percentile		50th percentile		75th percentile		90th percentile		95th percentile	
	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS
05—	14.0	16.0	14.6	16.3	16.4	18.1	17.5	19.6	19.4	21.2	22.1	22.9	23.7	24.6
06—	16.0	17.7	16.4	18.6	17.8	20.8	19.3	21.7	21.2	23.6	26.0	25.7	28.5	28.1
07—	18.0	19.5	19.1	20.4	20.3	22.0	22.1	24.0	25.0	26.3	30.9	29.1	32.4	32.7
08—	19.0	21.3	19.9	22.3	21.5	24.2	23.9	26.6	26.1	29.6	32.6	33.2	35.4	36.9
09—	19.1	23.5	20.0	24.3	21.8	26.6	24.5	29.7	26.9	33.4	32.3	38.1	35.5	42.3
10—	22.5	25.5	24.0	26.7	26.1	29.5	28.6	33.3	33.4	37.9	38.1	43.6	39.6	48.3
11—	24.4	28.2	25.8	29.7	28.3	33.0	33.3	37.4	39.0	43.0	45.8	49.6	50.7	54.7
12—	25.5	31.6	26.7	29.6	29.6	37.3	34.5	42.2	39.8	48.7	49.8	55.9	59.1	61.5
13—	26.6	35.8	29.5	38.0	32.5	42.4	37.5	47.8	40.6	55.0	54.3	62.3	59.6	68.5
14—	27.7	40.6	34.2	43.3	37.0	48.0	44.2	53.7	49.3	61.5	57.3	68.7	61.5	75.6
15—	31.9	45.5	35.2	48.6	37.1	53.6	43.1	59.5	51.2	67.6	59.6	74.9	70.0	82.4
16—	35.9	49.6	39.0	53.3	40.2	58.3	47.0	64.3	52.3	72.4	62.3	80.8	70.9	88.5
17—	42.0	52.8	44.5	48.5	48.0	61.6	51.5	67.7	56.7	75.3	60.8	86.1	71.6	93.7
18—	44.0	53.9	46.0	57.8	48.5	62.6	52.6	88.6	58.3	76.0	67.5	88.4	79.7	95.7

* NCHS values are those for 5.5, 6.5 years, etc., except at 18 years when the value for 18.0 years has been taken for comparison.

TABLE 8. Comparison of weight for age of S. Bridget's Convent females of 5-18 years with the corresponding NCHS values (smoothed data)

Age yrs.	5th percentile		10th percentile		25th percentile		50th percentile		75th percentile		90th percentile		95th percentile	
	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS	Sample	NCHS
05—	12.4	*15.2	13.2	15.9	13.9	17.0	14.6	18.5	16.1	20.3	22.1	22.4	22.6	24.1
06—	16.9	18.6	17.8	19.3	18.7	20.9	21.0	23.2	25.1	25.9	30.5	29.5	32.4	32.6
07—	16.9	18.6	17.8	19.3	18.7	20.9	21.0	23.2	25.1	25.9	30.5	29.5	32.4	32.6
08—	19.1	20.6	20.2	21.6	21.5	23.7	24.0	26.5	27.5	30.6	33.8	34.7	37.3	37.5
09—	21.3	23.0	22.5	24.2	24.7	26.9	28.3	30.4	29.6	34.9	39.4	40.6	42.3	43.8
10—	23.5	25.7	24.8	27.3	26.6	30.5	29.6	34.7	34.1	40.1	40.9	46.8	47.2	50.5
11—	25.7	28.8	27.2	30.7	28.3	34.4	33.0	39.2	38.1	45.4	44.5	53.0	52.1	57.4
12—	27.9	32.3	29.3	34.4	32.1	38.5	37.5	43.8	40.9	50.5	51.9	58.8	57.0	64.1
13—	30.1	35.9	32.2	38.2	37.6	42.6	40.6	48.2	44.2	55.1	51.7	63.8	61.9	70.3
14—	32.4	39.4	34.1	41.8	37.8	46.2	42.6	52.1	46.7	58.8	52.0	67.9	66.8	75.5
15—	34.7	42.3	35.8	44.7	39.9	49.1	44.9	54.9	49.2	61.4	53.9	70.9	71.8	79.5
16—	36.8	44.2	40.8	46.5	42.9	50.7	46.1	56.4	50.0	62.7	62.4	72.1	76.7	81.9
17—	39.0	45.0	41.1	47.3	45.9	51.3	50.3	56.7	57.6	62.8	66.0	72.3	81.6	82.6
18—	40.1	45.2	42.3	47.4	47.5	51.3	51.7	56.6	59.3	62.7	76.0	72.2	84.1	82.4

* NCHS values are those for 5.5, 6.5 years etc., except at 18 years when the value for 18.0 years has been taken for comparison.

HEIGHTS AND WEIGHTS OF SCHOOL CHILDREN

TABLE 9. The computed values for variances, gradients and intercepts obtained in the comparison regression lines of Sri Lankan and NCHS populations (ages 5 — 18 years)

	Centile	Sex	Computed Values		
			Variance	Gradient	Intercept
Height-for-age	25th	Males	0.76	2.23	0.50
		Females	0.23	0.11	1.20
	50th	Males	0.91	1.00	0.60
		Females	0.64	0.55	0.20
	75th	Males	0.78	2.16	2.88
		Females	0.68	0.40	2.50
Weight-for-age	25th	Males	0.43	4.81	6.94
		Females	0.24	4.44	5.72
	50th	Males	0.45	6.52	8.00
		Females	0.49	5.72	2.49
	75th	Males	0.92	5.64	7.88
		Females	1.07	5.06	10.50

Correlation coefficients of Sri Lankan and NCHS populations are both 0.99. The number of observations for each centile is 14.

For all centiles of height-for-age and weight-for-age the tabulated values are :

variances 4.16, gradients 2.49, intercepts 2.48.

Weight-for-age

When children between 5 and 18 years of age are considered, at all three centiles (the 25th, 50th and the 75th) and for both sexes, the NCHS population is heavier than the Sri Lankan (Tables 7 and 8). The differences are marginal until the age of 10 or 11, but the divergence thereafter is large. These differences are statistically significant,

The children between 5 and 9 years (inclusive) were compared with the NCHS population. Table 10 shows the computed values for variances, gradients and intercepts obtained in the comparison of regression lines of Sri Lankan and NCHS populations. There is no statistically significant difference between the weights of Sri Lankan boys and the NCHS population, at the 25th, 50th and 75th centiles. However, for girls in the same age groups, the NCHS population is significantly heavier than the Sri Lankan.

TABLE 10. Computed values for variances, gradients and intercepts in the comparison of regression lines for weights-for-age of Sri Lankans and NCHS population (ages 5 to 9, inclusive)

Centile	Sex	Computed values			Statistical Significance			
		Variances	Gradients	Intercepts	Variances	Gradients	Intercepts	Sample vs NCHS
25th	Males	1.50	1.65	0.20	ns	ns	ns	ns
	Females	1.01	1.16	4.62	ns	ns	s	s
50th	Males	0.32	1.48	1.43	ns	ns	ns	ns
	Females	1.00	1.68	3.54	ns	ns	s	s
75th	Males	1.03	1.50	2.04	ns	ns	ns	ns
	Females	0.83	2.45	6.88	ns	ns	s	s

ns—No statistically significant difference

s—Statistically significant difference

For all centiles and both sexes, the tabulated values

are : variances 15.9, gradients 2.90 intercepts 2.82

DISCUSSION

In 1936 Nicholls compared the heights and weights of boys at Royal College, Colombo (a fee-levying, state-aided, English-medium collegiate school at that time) with those in secondary schools (fee-levying, state-aided, English-medium) and with boys in vernacular schools (non-fee-levying, fully state-aided, Sinhala/Tamil medium). The height—distance curve for vernacular schools was the lowest, while the curve for Royal College boys was well above that for secondary school children. "Although the degree of growth varies greatly with the social status of the boys, yet the curves ran more or less parallel, indicating that the type of growth is much the same for all classes." The curve for British boys is very different; "it starts for the age five far below the curves for Ceylon boys and, passing diagonally upwards, it crosses the curves for the vernacular and secondary school boys at the points for ages 7 to 10, respectively, to reach the curve for the Royal College boys at a point for the age of nineteen". Similarly, for girls, the height distance curve for secondary schools was above the vernacular school curve. "The British girls, starting at the age of 5 below the Ceylon girls, have overtaken them at the age of 10 and 14 respectively, and continue to grow much taller than the Ceylon girls, who cease to grow at the age of 16" (8).

The children included in the present study are drawn from the same socio-economic-educational level as those who attended Royal College 52 years ago. Tables 5 and 6 indicate that the height-distance curves for Sri Lankan children compare very favourably with those of the NCHS population for the age group 5 to 9 years. The curves diverge thereafter, the NCHS values being higher. At age 16/17 however the Sri Lankan values are higher than the NCHS values. Because of this phenomenon, for the 25th and 50th centiles, the difference between the two sets of values is not significant when the entire age group 5 to 18 is considered (Table 9).

On the other hand the NCHS weight-for-age reference values for girls are well above the corresponding values for Sri Lankan girls, both in the 5-9 year group as well as in the 5 to 18 year range. The weights of Sri Lankan boys, however compare well (Table 10) with the NCHS values between ages 5 to 9 years (both inclusive). Adolescent boys, like the girls, are significantly lighter than their American counterparts. The differences between the NCHS and Sri Lankan population is probably due to difference in body composition, especially during and subsequent to the adolescent spurt, differences most likely contributed to by body fat. Whether it is advisable for Sri Lankan children to attain the body weight of the NCHS population is uncertain.

Balasuriya and Fernando (9) found that both Tamil and Sinhalese children attending fee-levying schools in Jaffna and Kandy were taller and heavier than those attending non-fee-levying state-aided schools in Nuwara Eliya. The heights and weights for Sri Lankan children were below the 2.5th centile of the NCHS values. Their population was more heterogeneous and belonged to a lower socio-economic level than the children included in the present study. There is also the effect of altitude to be considered. Those born and bred in the Nuwara Eliya district (altitude above 1800 m) could be more stunted than those at sea level.

Lucas, Samarasuriya and Fernando (10) have formulated centile charts for heights and weights which they claim are more applicable to Sri Lankan children. Their population was very heterogeneous and included several non-fee-levying, state-aided schools, and their growth cannot be viewed as the "attainable growth" for Sri Lankan children. Their 50th centiles of height-for-age is well below the values in Tables 5 and 6. Further the measuring techniques used by them fall far short of the standards required by the WHO for a reference population.

The results of the present study indicate that the NCHS height-for-age and weight-for-age reference values for the age group 5 to 9 years are "attainable" by Sri Lankan boys, except at centiles above the 75th. For girls, height-for-age NCHS reference values are attainable between the ages 5 to 9 years, but not the weight-for-age reference values.

If the height-for-age values for the two populations are similar and the weight-for-age values for Sri Lankans diverge greatly from the NCHS values, it would be incorrect to use the weight-for-height NCHS reference values to assess the degree of "wasting" in Sri Lankan school children under 10 years, especially in girls. In tropical climates one would expect an individual to remain slim though tall and thus increase his body surface area in order to dissipate body heat. In colder climates the body would be more spherical than cylindrical, to retain body heat.

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