Nutritional problems among Sri Lankan primary school children aged 5-9 years

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ABSTRACT

Background: The nutrition and health of school-age children has been one of the concerns of the Government of Sri Lanka since independence. Restructuring of the health programmes through school system was highlighted as a need.

Objectives: Assess the common nutritional problems among primary school children aged 5-9 years in Sri Lanka and the extent of the problem within the country.

Methods: A study conducted to represent national cross section of 7,200 primary school children aged 5-9 years. All were clinically examined for bitot's spot and goitre. Weight and height was measured on each subject's. WHO/NCHS reference was used to estimate prevalence of wasting, stunting and underweight. International obesity task force (IOTF) age-sex-specific BMI reference was used to estimate overweight and obesity. Haemoglobin concentration was assessed in randomly selected 3,143 subjects. Age specific WHO defined cut-off points were used to assess the anaemia with adjusting the altitude.

Results: The prevalence of wasting, stunting, underweight, and overweight was 16.7%, 17.3%, 29.8% and 1.0% respectively. The prevalence of anaemia, vitamin A deficiency and iodine deficiency were 16.5%, 0.3% and 4.1% respectively. According to the IOTF criteria 1.7% of them were overweight, 0.6% were obese and urban school subjects had eight times higher risk of becoming overweight and ten times risk of developing obesity than the rural school counterparts. The provincial variation of wasting was 13.3% to 20.8%, stunting varied from 9.8% to 23.8% and overweight ranged from 0% to 4.3%. Inter provincial variation of anaemia was 9.4% to 20.9%. There was an improvement of mean weight and height among boys and girls in relation to the studies in the past.

Conclusions: School health programmes should be targeted effectively to improve the double burden of nutritional problems among primary schoolchildren aged 5-9 years in collaboration with Ministry of health and education.

Key words:

Primary schoolchildren, wasting, underweight, stunting, overweight, anaemia

INTRODUCTION

At present there are more children of school age, and more school going children than ever before. Ill health and nutrition compromises both the quality of life of school-age children and the potential to benefit fully from their education, which might be the only education, they receive in their whole life [1].

Sri Lanka has a school going population of nearly 3.9 million (21% of the total population) as in year 2005. Of them about 1.6 million are primary school children. The Ministry of Education runs 9,727 schools island-wide. Schooling starts at Grade 1 on completion of 5 years of age and it has been made compulsory by legal enactment till 14 years of age. However, approximately 95% of all Sri Lankan children are enrolled in school at this age and there is no gender difference on enrolment [2].

Poor nutritional status was identified by various studies carried out in the past. A recent national study indicated that the prevalence of thinness, among schoolchildren (n=2,731) aged 9-15 years was 52.6%, stunting was 15.5% and overweight was 3.1% [3]. In 2002, schoolchildren (n=1,224) aged 8-12 years in seven schools of the Colombo city were assessed and found thinness, stunting, overweight and obesity was 17.5%, 2.6%, 13.2% and 6.3% in private schools, 23%, 7.8%, 13.5% and 3.3% in public-national schools and 31%, 9.3%, 6.0% and 1.5% in public non national schools respectively [4]. The prevalence of anaemia among primary schoolchildren was reported in year 1996 as 58% and 21% in year 2001 [5,6]. Goitre prevalence was recorded as 20.7% in year 2000, in the survey carried out to assess iodine deficiency among schoolchildren aged 8-9 years [7].

Sri Lanka has decades of experience in improving the nutrition and learning of schoolchildren through school based health and nutrition pogrammes in response to the findings of these studies. To improve the nutritional status of schoolchildren different ministries carry out a wide variety of programmes. The Ministry of Health initiated the school medical inspection from year 1926 by establishing the school medical office and has been screening all children of grade 1, 4 and 7 in public schools by measuring height and weight. Under nutrition of schoolchildren has been relieved by a wide variety of intervention programmes by the Ministry of Education, e.g. biscuits, buns, milk, school lunch etc. In addition to that the home gardening and school gardening programmes were initiated in collaboration with the Ministry of Agriculture. Though the interventions are not assessed properly to see the real effect, some benefits to the schoolchildren may have been observed.

Sri Lanka is administratively divided into 9 Provinces. Routine nutrition screening of schoolchildren by the public health staff of different Provinces highlighted high rates of under nutrition in some Provinces and emerging issues of overweight among school children in urban schools in spite of all these programmes. Therefore Ministry of health addressed this issue to relevant officials of Ministry of education and indicated that poor nutrition in schoolchildren seriously compromises their health and learning capacity. Ministry of health further discussed with relevant Educational authorities to use the infrastructure of the school system to reach children in a cost-efficient way and to use schoolchildren as messengers to promote good health within their families and communities as well. As a result of this, "National school health working committee" was formed in collaboration with Ministry of Education and Ministry of Health.

Ministry of Education planned to initiate the mid day meal programme for primary schoolchildren in selected schools. Therefore Ministry of health was invited by the Ministry of education to conduct the study to estimate the prevalence of under nutrition in different administrative Provinces in Sri Lanka to priorities the mid day meal programme. By considering the above, Ministry of health jointly with Ministry of Education initiated activities to revamp the school health programme in year 2001. Department of Nutrition at Medical Research Institute was handed over the task of conducting baseline nutritional assessment which was identified before initiation of the targeted nutrition interventions. Hence this study was carried out with the following objectives; to assess the prevalence of nutritional problems (wasting, stunting, underweight, overweight, Vitamin A deficiency, anaemia, iodine deficiency) among primary schoolchildren aged 5-9 years in different Provinces of Sri Lanka.

SUBJECTS AND METHODS

This is a cross sectional study among primary schoolchildren of 5-9 years of age in public schools to represent 9 administrative Provinces in the country. Calculated sample size for each province was 800 students by considering the prevalence estimates of wasting among children as 20% with the 95% of confidence interval and 5% error. Design effect was taken as 3 due to clustering effect of schools in Provinces.

The schools were selected from a list provided by the Department of Education. A multi-stage probability proportion sampling technique was used to identify the sample. During the first stage all

schools in each Province were listed out separately and 8 schools were selected by population proportion to sampling technique to size of total primary schoolchildren in schools. All the selected schools were visited prior to the survey. Grade 1-5, which represents the children of 5-9 years, was selected to study. During the second stage of sampling, all classes of grade 1, 2, 3, 4 and 5 were listed out and one class from each grade was randomly selected from each chosen school. All students in selected classes were given a letter and consent form through the class teacher to obtain the consent from the parents prior to the study. In the selected classes who had obtained the consent of their parents and children below the age of 10 years were included to select the sample.

Twenty children were randomly selected from each selected class using attendance register with computer generated random numbers. Selected children were examined for the presence or absence of bitot's spot to detect Vitamin A deficiency, presence or absence of goitre to detect Iodine deficiency and they were included in the assessment of weight and height. Three teams comprised of 3 health personnel in a team who had previous experience of participating in nutritional surveys collected data and moved from one Province to other. A structured format was developed to obtain birthday and sex of children in the selected classes. Birthday was obtained from the attendance register which is updated from the birth certificate by the class teachers.

Anthropometric data were collected by specially trained three health personnel one in each team and they were standardised before the study. Heights and weights were measured using standard techniques described by the World Health Organisation (WHO) [8]. Height was measured by using stadiometer without foot ware and the head held in the Frankfurt horizontal plane. An electronic Seca weighing scale was used to weigh the students with a minimum of clothing without foot ware and accuracy of the weighing scales were checked everyday morning using the standard weights. The weights and heights were recorded to the nearest 0.1kg and 0.1cm respectively. The measurer variation was assessed by duplicating the 10% of measurements by the same measurer and repeating the 10% by the Nutrition Assistant. The coefficient variation of measurement error was 0.1.

Nine children from each selected class who undergone anthropometric assessment were randomly selected by using computer generated random numbers to assess the haemoglobin (Hb) level to detect

anaemia by Haemocue method. Finger pricked blood samples were taken from 3,143 students and age dependent haemoglobin levels were taken to detect anaemia by adjusting the altitude [9].

All fieldwork was completed during, November 2001 – March 2002. Ethical approval was obtained from the institution ethical committee. Permission was obtained from the relevant Ministry of education and health officials.

Age was calculated from the subject's birthday as 5.0-5.9=5 year, 6.0-6.9=6 year etc. Height-for-age, weight-for-age and weight-for-height Z scores were calculated by using Epi-info 6.0 (CDC,USA) software. The WHO/National Centre for Health Statistics (NCHS) reference data was used to estimate prevalence of stunting (height-for-age <-2SD), prevalence of wasting (weight-for-height <-2SD), prevalence of underweight (weight-for-age <-2SD) and prevalence of overweight (weight-for-height >2SD) [10]. Body Mass Index (BMI) was calculated from height and weight. The age and sex specific BMI reference proposed in 2000 by the international obesity task force (IOTF) was also used to define overweight and obesity [11]. Cluster sample analysis was carried out by using Epi-Info 6.0 software package. Prevalence is presented with 95% confidence intervals. Anova test, Chi square test and odds ratio was calculated and the level of significance was taken at 0.05.

RESULTS

A total of 7,200 schoolchildren aged 5-9 years in 72 schools were enrolled in the study. Gender distribution in the sample was 51% of boys and 49% of girls. Distribution of subjects within age groups was not even. Number of children in the 7 years age group was smaller than other groups. This may be due to non consideration of age during the selection of samples. Subjects were selected on the basis of grade.

Table 1 shows the mean height, mean weight, mean body mass index (BMI) and means Z scores of the subjects. Analysis showed that the boys were significantly taller and heavier than girls at all ages (P=0.000). Mean weight, mean height and mean BMI was significantly increasing with the increasing age in both boys and girls (P = 0.000). Boys had significantly higher mean BMI than girls in all ages (P = 0.000). The mean Z score for both height and weight in different ages were between the -0.8 and -1.3 and -1.2 to -1.7 respectively.

Prevalence of wasting

Study findings revealed that the prevalence of wasting (percentage below the -2SD of NCHS/WHO weight-for-height reference) of the children studied was 16.7% as shown in Table 2. The boys showed a significantly higher prevalence of wasting than girls (18.8% in boys and 14.5% in girls; P = 0.000). In girls, wasting reduced at the age of 6 years (15.4%) and increased with the increasing age (from 16.0% to 17.9%; P = 0.4), but the increasing pattern of wasting was observed in boys from the age of 5 years to 9 years (17.2% to 20.2%; P = 4.3). The highest prevalence of wasting (20.2%) was observed at the age of 9 years in boys.

Prevalence of stunting

The prevalence of stunting (percentage below the -2SD of NCHS/WHO height-for-age reference) was 17.3% and significantly higher among boys than girls (19.5% in boys and 15.1% in girls; P = 0.00). Stunting significantly increased with the increasing age in boys up to 7 years (from 17.0% to 22.5%; P = 0.000). The significantly increasing pattern of stunting was observed in girls from the age of 5-7 years (11% to 18.9%; P = 0.000). The highest prevalence of stunting (22.5%) was observed at the age of 6 and 7 years in males.

Prevalence of underweight

Prevalence of underweight among boys (33.6%) was higher than girls (26%) and showed 29.8% of overall prevalence. The highest prevalence of underweight was 40.2% at the age of 6 years in boys.

Prevalence of overweight

Prevalence of overweight among boys (1.1%) was higher than girls (0.8%) and showed 1% of overall prevalence. When the prevalence of overweight was calculated using IOTF cut-off values indicated 1.7% overall prevalence and same prevalence in both boys and girls. The prevalence of obesity was 0.6%. The highest prevalence of overweight and obesity was observed at the age of 5 years with both classifications.

Prevalence of iodine deficiency

Presence of goitre was examined among all 7,200 students and the children who were found with visible or palpable goitre were considered as Iodine deficient (IDD) children (Table 3). It showed that 4.1% of prevalence with no significant difference between males (2.9%) and females (3.5%). Goitre

prevalence was significantly increased with the increasing age and the highest prevalence (8.1%) was observed at the age of 9 years among both boys and girls.

Prevalence of Vitamin A deficiency

Presence of bitot's spots was examined among all 7,200 students and the children who were found with bitot's spot were considered as Vitamin A deficient (VAD) children (Table 3). It showed that 0.3% of prevalence with no significant difference between males (0.4%) and females (0.3%). The highest prevalence of bitot's spot (0.7%) was found among the children aged 9 years among both boys and girls.

Prevalence of anaemia

A total of 3,143 were tested for anaemia. Mean Hb was 12.6 (1.1) ranging from 12.2-12.8 g/dl (Table 3). Prevalence of anaemia decreased till age of 8 years (21.7%-11.8%), then increased to 15% among children of 9 years of age. Boys (17.6%) were more anaemic than girls (15.3%) except among 5 and 7 years of age group. Overall prevalence of anaemia was 16.5%. Highest prevalence of anaemia was observed at the age of 5 years (24.6%) among girls.

Sector variation

Table 4 shows prevalence of nutritional problems divided into urban and rural categories. Children from rural schools have shown high rate of stunting than children from urban schools (8.5% in urban and 18.6% in rural; P=0.000). There was a significant high level of wasting (14.8% in urban and 17.1% in rural;P=0.03), underweight (17.4% in urban and 31.5% in rural; P=0.000), presence of goitre (2.4% in urban and 4.3% in rural; P=0.00) and anemia (10.1% in urban and 17.5% in rural; P=0.000) among students attending rural schools than urban schools. Conversely subjects from urban schools (4.4%) were more overweight than counterparts (0.9%) from rural schools (Table 4).

Provincial variation

Table 5 shows that the provincial variation of nutritional problems among children aged 5-9 years in Sri Lanka. Western Province where capital of Sri Lanka (Colombo) located showed the lower prevalence of stunting (9.8%) and highest prevalence of overweight (4.3%). Seven Provinces shows more than 15% of wasting prevalence and the highest number of stunted children was found from the Provinces

(Uva and Central) where the wasting prevalence was less than 15%. Seven out of nine Provinces showed less than 1% of overweight prevalence.

Table 6 presents the highest prevalence of bitot's spot and goitre reported in Uva Province. The prevalence of anaemia was lowest in Western Province and highest in North Western Province.

Comparison with NCHS reference population

Figure 1 illustrates the growth pattern of children 5-9 years from 1936. The mean weight and height data of children were compared with the NCHS/WHO reference population [7]. The weight and height data of the well nourished well to do Elite urban Colombo schoolchildren were assessed in 1988. Mean height of urban well to do girls aged 5-9 years and up to 8 years for boys were above the NCHS reference then in boys 8-9 years fall in line with the NCHS reference population. On average, the weights of 5-9 years well to do schoolchildren were close to the international/WHO-NCHS growth standard up to 8 years, whereas those of above 8 years were just below the international standard. Other previous studies showed height and weight of both boys and girls fall far below the NCHS reference.

Results of our study indicate the improvement of growth of children 5-9 years over the years. There is a trend towards improving physical stature of the schoolchildren born in later years. Growths of the girls were better than boys. A comparison showed with the studies carried in 1936 and 1988 indicates that the growth pattern is better throughout the age in this study.

DISCUSSION

Good nutrition of schoolchildren is an investment in a country's future and in the capacity of its natives to thrive economically as a society (World Bank). This study provides the national and provincial representative data on the prevalence of wasting, stunting, underweight, overweight, anaemia, Vitamin A deficiency and iodine deficiency in Sri Lankan children aged 5-9 years attends public school. The overall prevalence of wasting, stunting, underweight and overweight in our study was 16.7%, 17.3%, 29.8% and 1.0% respectively.

In this study, NCHS/WHO reference was used as recommended by the WHO (1995). This will enable comparisons to be made with results obtained in other countries. Children above 10 years of age was excluded from the study due to difficulties arise with the use of NCHS reference for that age group. In addition to that IOTF criteria are used to classify overweight and obesity for international comparison [8].

Boys were taller and heavier than the girls. These findings agree with the previous studies in Sri Lanka [9,10,11,12]. The height, weight and BMI data demonstrated that the growth pattern of primary schoolchildren on average was far below to the WHO reference standard.

Our findings of the prevalence of wasting and stunting among primary schoolchildren are higher than the prevalence among preschool children (14% of wasting and 13.5% of stunting) reported in the DHS survey (2001) but the prevalence of underweight (29.8%) was the same. This study showed a lower level of wasting and stunting than a recent analysis of anthropometric measurements in Ghana, Tanzania, Indonesia, Vietnam and India. It highlighted that a large proportion of children were stunted and over 20% of them were wasted (Andrew and don bundy).

A higher proportion of boys than girls are stunted which is comparative to findings in other countries [13]. This difference may be due to boys aged 5-9 years in general spend more time playing outside than girls do. Therefore girls have better physical access to available food. The lowest prevalence of stunting and the highest prevalence of overweight were found at the age of 5 years. It indicates children at 5 years have been exposed to better nutrition since early childhood than their older counterparts. Schoolchildren from rural schools are more stunted than children from urban schools by a wide margin (8.5% in urban and 18.6% in rural). This almost certainly reflects differential access to livelihood and services.

An increase prevalence of overweight among children was observed in this study in certain Provinces. Children attends urban schools had 8-10 times risk of developing overweight and obesity than the children attends rural schools. Anthropometric data of the school health programme should be used to monitor the trends at National and Provincial level. This can be achieved by including all children up to 18 years of age at least once a year for the anthropometric assessment. The co-existence of

underweight and overweight within the country can be monitored throughput the country which will facilitate to support the formulation of evidence based policies and programmes.

VAD is a significant problem among school age children in many countries. In this study, it showed that urban school children were more affected from VAD than rural school children. This finding is not compatible with the studies carried out in the past (). Clinical VAD manifest on eye lesion is decreasing in Sri Lanka after adopting a policy supporting the regular supplementation of Vitamin A mega dose among preschool and school children. Supplementation coverage has increased significantly in the last few years with integrating the administration of Vitamin A supplements to the school health programme. The survey highlights the magnitude and location of the VAD problem in certain Provinces. Some Provinces indicated (e.g. Uva, Central) in Sri Lanka suffer from multiple nutrient deficiency (stunting, wasting, VAD, IDD). It may be difficult for needs to be met through diet along; multiple micronutrient supplementation or fortification holds clear potential to address this. However, the finding of this study indicates the need to extent Vitamin A megadose programme among all primary schoolchildren with awareness programme.

In this study it was found that 16.7% of schoolchildren aged 5-9 years suffer from anaemia. Iron deficiency and its most serious manifestation, anaemia especially continues to undermine school performance due to impaired cognitive development, fatigue and poor attention span. National anaemia survey indicated in 2002 that 20.9% of primary schoolchildren aged 5-10 years were anaemic. Recent estimates based on WHO global database suggest that 7.8% of school aged children in industrialised countries and 53% in developing countries are anaemic. High prevalence of anaemia in schoolchildren was found in Asia (58.4%) and Africa (49.8%). Anaemia prevalence was highest in North Western Province where the malaria and Thalassaemia common. Lower prevalence reported from Western Province where the services are more accessible.

Worm infestation and malaria are the common causes of anaemia. Recent study reported that overall prevalence of worm infestation among schoolchildren aged 9-15 years was 6.5% with 1% prevalence of hook worm infestation and 95% of children were given worm treatment during last 6 months. This may be the reason for the low prevalence of worm infestation in this population. Ministry of Health provide worm treatment for all the children in grade 1 and 4 in public schools through school health

programme annually. Malaria is endemic in Sri Lanka. However, it was reported that only 6.5% of school children have contracted malaria in their lifetime. In this study school children aged 5-9 years shows “medium” level of public health significance of anaemia as suggested by the WHO classification system [ ]. Inter Provincial distribution is also showed a “medium” to “low” level of public health significance. The lowest prevalence of anaemia was reported in Western Province.

When the iodine deficiency figures are transformed into numbers affected by goitre or at risk of IDD (that is living in a geographical region where the total goitre rate in school age children is >5%), it is clear that the national scale of the problem as “public health problem” is minimum. This may be due to Universal salt iodisation established from 1995 in the country. However, IDD is still prevalent in some Provinces indicating the monitoring of iodisation programme very closely.

Our study indicated differences in mean height with the reference has reduced compared with studies carried out in 1936 and 1985. However, the data presented in Figure 1 shows that the difference of the mean height and weight among children aged 5-9 years showed in various studies are not due to genetic differences. Data on growth of children 5-9 years aged overtime shows that the marked improvement of growth pattern. The physical growth of schoolchildren aged 6-9 year age is the result of both environmental and genetic factors and the interaction between these factors. This data confirm the main factor affecting the physical growth of school age children are environmental factors experience before puberty. The growth of the affluent children could be considered the “attainable growth”. Therefore, the findings of present study highlights the unsatisfactory growth of the Sri Lankan primary schoolchildren and it should be planned for the future to raise the mean value for the whole population of primary schoolchildren at least within minus one SD of the NCHS median.

School feeding programmes are one of several interventions that can address some of the nutrition and health problems of school-age children. Our study identifies and target population sub group (geographical, age) need food to achieve these goals. This may help for transparent targeting with clarity on whom is targeted and why. Consider timing breakfast or morning snacks is generally better than lunch for alleviating hunger and achieving learning objectives.

CONCLUSIONS

This study showed a high prevalence of wasting with emerging problems of overweight and obesity coexisting with stunting and anaemia in Sri Lankan primary schoolchildren aged 5-9 years. Health and Education authorities could target specific intervention through school-based programmes, and more beyond school feeding programme to include multiple micronutrient programme and behaviour modification as part of a broader range of interventions. A part from the school feeding programme, health and education authorities should provide nutrition education and sensitizing the public to proper nutrition and feeding habits and diet diversification to control the nutritional problems among schoolchildren. It is recommended to target the school mid day meal programme to reduce the nutritional problems among schoolchildren aged 5-9 years. School health programme should be extended throughout the school years from grade 1 -13 for easy and continuous monitoring of the nutritional problems to formulate appropriate programmes that are beneficial to children, manageable by the schools and affordable by the parents.

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Table 1
Distribution of mean height, weight and body mass index by sex and age

Age (years)	No.	Height (cm)		Weight (kg)		BMI (kg/m^2)
		Mean ±SD	Mean Z score±SD	Mean±SD	Mean Z score± SD	Mean ±SD
Male						
5	535	108.7±4.6	-1.0±1.0	16.6±2.4	-1.5±1.1	16.6±2.4
6	991	111.7±5.1	-1.3±1.0	17.3±2.4	-1.7±0.9	17.3±2.4
7	209	117.7±5.5	-1.2±1.1	19.2±2.8	-1.7±0.9	19.2±2.8
8	715	123.7±5.9	-1.1±1.0	21.7±3.8	-1.5±1.0	21.3±3.8
9	1224	127.8±5.7	-1.1±1.0	23.4±4.1	-1.5±0.9	23.4±4.1
Female						
5	575	108.2±4.8	-0.8±1.0	16.3±2.8	-1.2±1.1	16.3±2.8
6	957	111.0±4.9	-1.1±0.9	16.9±2.3	-1.4±0.9	16.9±2.3
7	196	116.4±5.5	-1.0±1.0	18.5±2.9	-1.5±0.9	18.4±2.9
8	722	122.7±5.5	-1.0±0.9	21.3±3.8	-1.4±0.9	21.3±3.8
9	1076	126.4±5.4	-1.2±0.8	22.5±3.5	-1.6±0.7	22.5±3.5
Test statistics		F=3643.2 P=0.000	F=18.1 P=0.000	F=1288.4 P=0.000	F=15.6 P=0.000	F=1288.4 P=0.000

Table 2
Prevalence of wasting, stunting, underweight and overweight in relation to the age and sex

Characteristic	Sex	Prevalence (%) (CI)					Total	Test
		Age in years					n=7200	statistics
		5 (n=1110)	**6** (n=1948)	**7** (n=405)	**8** (n=1437)	**9** (n=2300)		
Wasting[a]	Male	17.2 (14.0-20.4)	17.5 (15.1-19.8)	19.1 (13.8-24.5)	19.4 (16.5-22.3)	20.2 (17.9-22.4)	**18.8 (17.5-20.1)**	χ^2=3.8 P=4.3
	Female	15.0 (12.0-17.9)	13.3 (11.1-15.4)	17.9 (12.5-23.2)	13.6 (11.1-16.1)	15.3 (13.2-17.5)	**14.5 (13.3-15.7)**	χ^2=4.2 P=0.4
	Total	**16.0 (13.9-18.2)**	**15.4 (13.8-17.0)**	**18.5 (14.7-18.4)**	**16.5 (14.6-18.4)**	**17.9 (16.3-19.5)**	**16.7 (15.8-17.6)**	**χ^2=6.2 P=0.2**
Stunting[b]	Male	17.0 (13.8-20.2)	22.5 (19.9-25.1)	22.5 (16.8-28.1)	17.6 (14.8-20.4)	18.7 (16.5-20.9)	**19.5 (18.2-20.8)**	χ^2=11.1 P=0.03
	Female	11.0 (8.4-13.5)	16.2 (13.9-18.5)	18.9 (13.4-24.4)	13.7 (11.2-16.2)	16.6 (14.4-18.9)	**15.1 (13.9-16.3)**	χ^2=13.8 P=0.008
	Total	**13.9 (11.8-15.9)**	**19.4 (17.6-21.2)**	**20.7 (16.8-24.7)**	**15.7 (13.8-17.5)**	**17.7 (16.2-19.3)**	**17.3 (16.5-18.2)**	**χ^2=21.5 P=0.000**
Underwt[c]	Male	33.3 (29.3-27.3)	40.2 (37.1-43.2)	36.4 (29.8-42.9)	30.9 (27.5-34.3)	29.4 (26.9-32.0)	**33.6 (32.0-35.1)**	χ^2=31.8 P=0.000
	Female	24.0 (20.5-27.5)	25.9 (23.1-28.7)	29.1 (22.7-35.4)	24.0 (20.8-27.1)	27.8 (25.1-30.5)	**26.0 (24.5-27.4)**	χ^2=5.5 P=0.2
	Total	**28.5 (25.8-31.1)**	**33.2 (31.1-35.3)**	**32.8 (28.3-37.4)**	**27.4 (25.1-29.7)**	**28.7 (26.8-30.5)**	**29.8 (28.8-30.9)**	**χ^2=18.6 P=0.000**
Overweight[c]	Male	0.7 (0.0-1.5)	0.7 (0.2-1.2)	0.5 (-0.5-1.0)	2.0 (0.9-3.0)	1.2 (0.6-1.8)	**1.1 (0.8-1.5)**	χ^2=7.7 P=0.1
	Female	2.3 (1.3-3.5)	0.4 (0.8-1.0)	1.0 (-0.4-2.4)	0.8 (0.2-1.5)	0.4 (0.0-0.7)	**0.8 (0.5-1.1)**	χ^2=19.3 P=0.001
	Total	**1.5 (0.8-2.3)**	**0.6 (0.2-0.9)**	**0.7 (-0.1-1.6)**	**1.4 (0.8-2.0)**	**0.8 (0.5-1.2)**	**1.0 (0.7-1.2)**	**χ^2=10.3 P=0.04**
Overwt. IOTF[e]	Male	2.2 (1.0-3.5)	1.1 (0.5-1.8)	1.0 (-0.4-2.3)	2.4 (1.3-3.5)	1.8 (1.1-2.5)	**1.7 (1.3-2.1)**	χ^2=5.6 P=0.2
	Female	4.0 (2.4-5.6)	0.8 (0.3-1.4)	2.0 (0.1-4.0)	1.7 (0.7-2.6)	1.1 (0.5-1.7)	**1.7 (1.3-2.1)**	χ^2=25.2 P=0.000
	Total	**3.2 (2.1-4.2)**	**1.0 (0.5-1.4)**	**1.5 (0.3-2.7)**	**2.0 (1.3-2.7)**	**1.5 (1.0-2.0)**	**1.7 (1.4-2.0)**	**χ^2=21.7 P=0.000**
Obesity[f]	Male	1.9 (0.7-2.0)	0.2 (-0.1-0.5)	0	0.4 (-0.1-0.9)	0.7 (0.2-1.1)	**0.6 (0.4-0.9)**	χ^2=17.9 P=0.001
	Female	1.7 (0.7-2.8)	0.3 (-0.0-0.7)	0	0.7 (0.1-1.3)	0	**0.5 (0.3-0.7)**	χ^2=24.8 P=0.000
	Total	**1.8 (1.0-2.6)**	**0.3 (0.0-0.5)**	**0.0**	**0.6 (0.2-0.9)**	**0.3 (0.1-0.6)**	**0.6 (0.4-0.7)**	**χ^2=37.5 P=0.000**

(CI=95% confidence interval)

a. Weight-for-height <-2SD [5]

b. Height-for-age < -2SD [7]

c. Weight-for-age < -2SD [7]

d. Weight-for-height >2SD [7]

e. Percentiles passing BMI of 25 kg/m^2 (IOTF) [8]

f. Percentiles passing BMI of 30 kg/m^2 (IOTF) [8]

Table 3
Prevalence of anaemia, Vitamin A deficiency in relation to the age and sex

Characteristic	Sex	Prevalence (%) (CI)					Total	Test statistics
		Age in years						
		5 (n=1110)	**6** (n=1948)	**7** (n=405)	**8** (n=1437)	**9** (n=2300)	(n=7200)	
Presence of bitot's spot[b]	Male	0.2 (-0.2-0.6)	0.4 (0.0-0.8)	0.0	0.4 (-0.1-0.9)	0.6 (0.1-1.0)	**0.4 (0.2-0.6)**	χ^2=2.3 P=0.7
	Female	0.0	0.0	0.0	0.0	0.8 (-0.1-1.2)	**0.3 (-0.0-0.4)**	χ^2=20.6 P=0.000
	Total	**0.1 (-0.1-0.3)**	**0.2 (0.0-0.4)**	**0.0**	**0.2 (-0.0-0.4)**	**0.7 (0.4-1.0)**	**0.3 (0.2-0.5)**	**χ^2=14.1 P=0.007**
Presence of goitre[b]	Male	0.0	0.3 (-0.0-0.6)	0.5 (-0.5-1.4)	4.1 (2.6-5.5)	6.0 (4.7-7.4)	**2.9 (2.4-3.5)**	χ^2=90.1 P=0.000
	Female	0.0	0.4 (-0.2-1.1)	0.0	6.3 (3.3-9.3)	6.4 (4.3-8.4)	**3.5 (2.6-4.5)**	χ^2=167.3 P=0.000
	Total	**0.1 (-0.1-0.3)**	**0.4 (0.1-0.6)**	**0.5 (-0.2-1.2)**	**6.9 (5.5-8.2)**	**8.1 (6.9-9.2)**	**4.1 (3.6-4.6)**	**χ^2=249.7 P=0.000**
Anaemia (g/dl)[a]	**No.**	396	853	139	557	1198	**3143**	
	Mean Hb (SD)	12.2 (1.0)	12.6 (1.1)	12.8 (0.9)	12.8 (1.1)	12.6 (1.1)	**12.6 (1.1)**	F=18.3 P=0.000
	Male	18.7 (13.2-24.2)	21.8 (17.9-25.7)	11.8 (4.6-19.1)	14.2 (13.8-14.2)	16.8 (13.9-19.7)	**17.6 (15.8-19.4)**	χ^2=9.67 P=0.05
	Female	24.6 (18.7-30.6)	17.8 (14.2-21.5)	14.3 (5.6-22.9)	9.0 (5.5-12.5)	12.9 (10.1-15.7)	**15.3 (13.5-17.1)**	χ^2=25.9 P=0.000
	Total	**21.7 (17.7-25.8)**	**19.8 (17.1-22.5)**	**13.0 (17.4-18.5)**	**11.8 (9.2-14.5)**	**15.0 (13.0-17.0)**	**16.5 (15.2-17.8)**	**χ^2=26.5 P=0.000**

Table 4
Prevalence of nutritional problems among primary schoolchildren by sector

Characteristic	Sector		Test statistics
	Urban (n=869)	Rural (n=6331)	
	Prevalence (% and CI)		
Wasting	14.0 (11.7-16.3)	17.1 (16.1-18.0)	OR=0.8 (0.6-1.0) P=0.03
Stunting	8.5 (6.7-10.4)	18.6 (17.6-19.5)	OR=0.4 (0.3-0.5) P=0.000
Underweight	17.4 (14.9-19.9)	31.5 (30.4-32.7)	OR=0.5 (0.4-0.6) P=0.000
Overweight	4.4 (3.0-5.7)	0.5 (0.3-0.7)	OR=0.1 (0.1-0.2) P=0.000
Overweight (IOTF)	7.3 (5.5-9.0)	0.9 (0.7-1.2)	OR=8.2 (5.7-11.7) P=0.000
Obesity	2.8 (1.7-2.9)	0.3 (0.1-0.4)	0R=10.5 (5.6-19.7) P=0.000
Presence of bitot's spots	0.6 (0.1-1.1)	0.3 (0.2-0.4)	0R=1.9 (0.7-5.2) P=0.2
Presence of goitre	2.4 (1.4-3.4)	4.3 (3.8-4.8)	OR=1.8 (1.2-2.9) P=0.00
Anaemia (g/dl)	n=435 10.1 (7.3-12.9)	n=2708 17.5 (16.1-19.0)	OR=0.5 (0.4-0.7) P=0.000

Table 5
Prevalence of wasting, stunting, underweight and overweight in different Provinces

Province	Prevalence (%) (CI)					
	Wasting [a]	**Stunting** [b]	**Underweight** [c]	**Overweight** [d]	**OverwtIOTF** [e]	**Obesity** [f]
Western (n=800)	16.8 (14.2-19.3)	9.8 (7.7-11.8)	20.1 (17.3-22.9)	4.3 (2.9-5.6)	7.1 (5.3-8.9)	2.3 (1.2-3.3)
Central (n=800)	14.9 (12.4-17.3)	26.6 (23.6-29.7)	39.6 (36.2-43.0)	0.1 (-0.1-0.4)	0.1 (-0.1-0.4)	0
Southern (n=800)	17.6 (15.0-20.3)	13.5 (11.1-15.9)	23.5 (20.6-26.4)	1.5 (0.7-2.3)	2.1 (1.1-3.1)	0.8 (0.2-1.3)
Northern (n=800)	15.6 (13.1-18.1)	17.3 (14.6-19.9)	27.4 (24.3-30.5)	0.6 (0.1-1.2)	1.0 (0.3-1.7)	0.1 (-0.1-0.4)
Eastern (n=800)	20.8 (17.9-23.6)	16.0 (13.5-18.5)	32.6 (29.4-35.9)	0.4 (-0.0-0.8)	1.0 (0.3-1.7)	0.4 (-0.0-0.8)
North Western (n=800)	17.6 (15.0-20.3)	9.5 (12.4-17.3)	27.5 (24.4-30.6)	0.9 (0.2-1.5)	1.6 (0.7-2.5)	1.0 (0.3-1.7)
North Central (n=800)	15.1 (12.6-17.6)	17.6 (15.0-20.3)	30.3 (27.1-33.4)	0.5 (0.0-1.0)	1.3 (0.5-2.0)	0.3 (-0.1-0.6)
Uva (n=800)	13.3 (10.9-15.6)	23.8 (20.8-26.7)	36.4 (33.0-39.7)	0.0	0.3 (-0.1-0.6)	0
Sabaragamuwa (n=800)	18.6 (15.9-21.3)	16.8 (14.2-19.3)	31.1 (27.9-34.3)	0.5 (0.0-1.0)	0.9 (0.2-1.5)	0.4 (-0.0-0.8)
Total (n=7200)	**16.7 (15.8-17.6)**	**17.3 (16.5-18.2)**	**29.8 (28.8-30.9)**	**1.0 (0.7-1.2)**	**1.7 (1.4-2.0)**	**0.6 (0.4-0.7)**

CI = 95% confidence interval

a. $\chi^2 = 23.4$, P=0.000

b. $\chi^2 = 116.0$, P=0.000

c. $\chi^2 = 112.4$, P=0.000

d. $\chi^2 = 113.2$, P=0.000

e. $\chi^2 = 171.8$, P=0.000

f. $\chi^2 = 57.5$, P=0.000

Table 6
Prevalence of anaemia, Vitamin A deficiency, iodine deficiency in different Provinces

Province	No.	Presence of bitot's spot [a]	Presence of goitre[b]	Anaemia (g/dl)[c]	
		(%) (CI)		No.	(%) (CI)
Western	800	0.3 (-0.1-0.6)	1.3 (0.5-2.0)	360	9.4 (6.4-12.5)
Central	800	0	1.5 (0.7-2.3)	306	20.9 (16.4-25.5)
Southern	800	0.4 (-0.0-0.8)	3.8 (2.4-5.1)	360	14.4 (10.8-18.1)
Northern	800	0.3 (-0.1-0.6)	3.8 (2.4-5.1)	360	11.9 (8.6-15.3)
Eastern	800	0.4 (-0.0-0.8)	5.3 (3.7-6.8)	360	18.1 (14.1-22.0)
North Western	800	0	6.0 (4.4-7.6)	360	21.9 (17.7-26.2)
North Central	800	0.4 (-0.0-0.8)	1.8 (0.8-2.7)	360	18.3 (14.3-22.3)
Uva	800	1.0 (0.3-1.7)	8.0 (6.1-9.9)	360	15.6 (11.8-19.3)
Sabaragamuwa	800	0.4 (-0.0-0.8)	5.6 (4.0-7.2)	317	18.9 (14.6-23.2)
Total	**7200**	**0.3 (0.2-0.5)**	**4.1 (3.6-4.6)**	**3143**	**16.5 (15.2-17.8)**

CI = 95% confidence interval

Anaemia cut-off points: 5-11 years <11.5 g/dL,

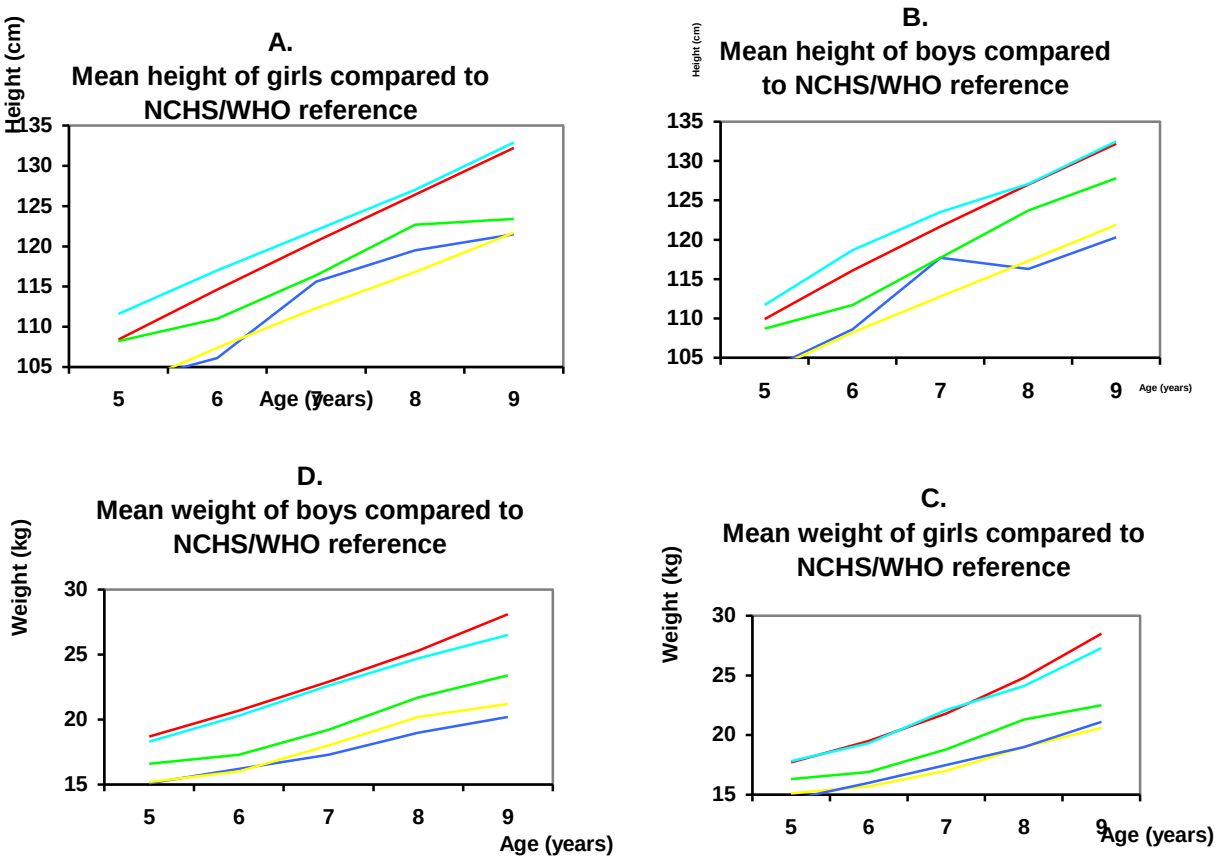
Altitudes were corrected [6].

a. $\chi^2 = 16.6$, P=0.04

b. $\chi^2 = 87.8$, P=0.000

c. $\chi^2 = 34.7$, P=0.000

Figure 1
Mean height of girls (A) and boys (B), and mean weight of girls (C) and boys (D), compared with WHO reference and previous studies



Very high levels of anaemia were not seen in any district. A high degree of anaemia has been shown in Anuradhpura, Vavuniya, Rathnapura and Kurunagala districts. When it comes to the adolescent group Colombo district has a low level of anaemia and other districts have a medium level of anaemia prevalence except in Monaragala and Rathnapura districts.

The district distribution pattern is shown in Figure 10. Bitot's spots were not found in Colombo, Rathnapura and Kurunagala districts. When the geographical distribution was taken into consideration, we can see that the clinical VAD is a public health problem in the Badulla district, but not in the whole country.

"As linear growth is a good proxy for general development constraints, trends in height-for-age provide information on long term changes in the environment and their nutritional consequences."

Prevalence of wasting which is indicative of acute under nutrition is 15.1% and more prevalent in boys than girls.

Undernutrition was more prevalent among adolescents than primary schoolchildren and more than half of boys were thin.

Prevalence of wasting and stunting was graded according to WHO classification (WHO Global Database) to assess the severity of the problem as follows: wasting (<5% - low, 5-9% - moderate, 10-14% - high and >=15 – very high) and stunting (<20% - low, 20-29% - moderate, 30-39% - high and >=40 – very high). In general, the severity of prevalence of wasting and stunting was compared by districts and geographical distribution was illustrated in the Figure 3 and 4.

The highest prevalence of stunting was reported in this study was in Badulla district which has 'moderate' degree of stunting. All other districts surveyed have mild degree of stunting. Figure 4 shows the wasting prevalence in the surveyed districts.

A ‘very high’ grade of wasting was found in Kurunagala, Monaragala, Vavuniya, Ampara, Rathnapura and Hambantota districts according to the population prevalence. All the other districts, which were studied, also have a high degree of wasting.

The proportion of the population with thinness was classified by WHO (1995) was used to classify the severity of the thinness as low (5-9%), medium (10-19%), high (20-39%) and very high (>=40%) prevalence. Prevalence of the thinness was calculated among adolescents and the geographical distribution by districts is shown in Figure 5.

Hambantota district has shown a ‘very high’ level of thinness and all the other districts studied have indicated high level. It is interesting to note that this observation is comparable with the pattern observed among primary school children except in Monaragala and Kurunagala districts. In these districts there is an improvement from very high level to high level from primary school to adolescents. This finding could be due to the possibility of children ‘catching up’ in their growth, as they become older.

“Failure of the growth of the individual may be a symptom of an underlying diet on health problem warranting intervention. It can also be seen as a marker of a high risk environment.”(ACC/SCN 1990)

Geographical distribution of overnutrition

The proportion of the school children with overweight was classified by taking arbitrary cut-off points to reflect the severity of the problem among children as follows: <1% - very low, 1-4% -low, 5-9% - medium and >=10% - high prevalence and geographical distribution is shown in Figure 6 and 7.

In this study it was found that there is ‘very low’ and ‘low’ prevalence of over weight among primary schoolchildren in all the districts studied except in Colombo district. Colombo district has a medium level of overweight prevalence among adolescents’ children and it showed a medium prevalence with primary schoolchildren also as shown in Figure 7. Even in other districts there is an increasing trend from ‘very low’ to ‘low’ prevalence. Rathnapura districts also shows the prevalence of overnutrition among adolescents to be ‘medium’.