Nutritional Status of Children in Different Types of Schools

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Introduction

The achievements of Kerala in the field of health have not been uniform across all sections of society. There is no reliable data regarding the differentials of nutritional status across socio-economic classes in Kerala. Hemoglobin values, rather than prevalence of anemia in different classes, along with anthropometry would be the ideal measure for this.

Schools in Kerala reflect the socio-economic divide more than any other institution. The well-off sections send their children to private unaided schools while the rest depend on government and private aided schools. Children studying in the unaided private schools are expected to be well nourished and their growth and hemoglobin levels are likely to be the maximum attainable in the population. Comparison of growth and hemoglobin levels of the children from the aided and government schools, as well as those from backward areas like the coastal belt and urban slums with those in the unaided private schools will help to quantify the deficit in the former and will be of immense help in planning nutrition supplementation or any other type of intervention.

Objectives

1. To measure blood Hemoglobin and anthropometric parameters in children studying in different types of schools and in disadvantaged areas of Kozhikode district.
2. To identify the type of anemia when present by peripheral smear examination.
3. To compare the hemoglobin values and anthropmetric parameters, so as to calculate the nutritional deficit in the disadvantaged populations
4. To assess the efficacy of mid-day meal scheme in the schools in preventing growth retardation and anemia.
5. To recommend measures for correction of the nutritional deficit in these populations

Subjects and Methods

862 children (457 boys and 405 girls) studying in the 4th standard from the following categories of schools in Kozhikode district were studied.

1. Urban unaided 2. Rural unaided 3. Urban Government 4. Rural Government

5. Urban aided 6. Rural aided 7. Coastal area 8. Slum area

The schools have been further categorized into three classes for purpose of analysis, namely

1. Upper class schools (Urban and rural Unaided schools)
2. Ordinary schools (Government and Aided schools)
3. Backward area schools (Schools in coastal and slum areas)

For each child, the date of birth, occupation of Guardian and Mid-day meal beneficiary status was obtained from the school register and recorded. Clinical examination was done particularly for evidence of nutritional deficiency, namely the presence or absence of Conjunctival xerosis, Bitot's spots, Angular stomatitis and Phrynoderma. Height, Weight and Mid upperarm circumference were measured by standard methods.

Hemoglobin was estimated by the Cyanmethemoglobin method. Peripheral smear was was studied and differential WBC count was done in each case.

Discussion was held with the teachers regarding the type of food served for the mid-day meal, availability of supplies and the number of days the meal was provided. The lunch was observed in five of the nine schools where the program was in place.

The NCHS/WHO reference standards were used to define underweight and stunting. The cut-off used to define anemia was 11.5 gm as recommended by WHO in 1998.

Results and Conclusions

1. There has been remarkable progress in growth parameters of children in Kerala in the last quarter century. Mean height and weight of nine year olds have increased considerably during the period. Even in backward area schools, there has been an increase

in mean height of 6.2 cm and 5.4 cm for boys and girls respectively.

2. Significant class differentials persist in the growth of children exemplified by the fairly wide differences between children in the unaided private schools vis a vis those in the other schools which account for 85% of the State's children.
3. The actual deficits in height and weight of children in these schools range from 3.5 to 7 cms and 3.5 to 6 kg respectively.
4. Gender difference (in favor of boys) is present only in the backward area schools and that too to a small degree.
5. Stunting is still a problem in the backward area schools affecting 12.9% of students. Underweight is more widespread affecting 46.3% and 65.5% respectively in ordinary and backward area schools.
6. Overweight is an emerging problem in the unaided schools affecting 10.6% of students
7. Prevalence of severe malnutrition is very low.
8. The mean hemoglobin is 11.8 g/dl. But 44.2% of children are anemic.
9. Anemia is more prevalent in urban ordinary schools and the coastal area. The deficit in hemoglobin in these schools compared to the unaided schools, ranges from 1.8 to 2.0 g/dl.
10. Gender difference in mean hemoglobin is not significant in the sample as a whole though there is a small but significant difference in the ordinary schools in favor of girls.
11. Prevalence of Eosinophilia is seen in as much as 23.7% of children in the coastal school and nearly ten percent of the children in the

urban ordinary and slum schools. Exposure to filarial antigens may be the cause.

12. The school lunch in its present form is designed prevents severe malnutrition, but fails as a 'catch-up' device to ensure optimum growth.
13. The menu offered is invariant and monotonous and does not interest the child. There is general lack of interest on part of the Government, Panchayats and the community.

With a modest outlay, and political will the school lunch program in Kerala can be made a model one, which ensures that all children attain their full genetic potential. Providing equality of opportunities in education encompasses taking care of the nutritional needs of all children for ensuring optimum growth and preventing learning disabilities. A pro-active role from the Government and community leaders is the need of the hour.

INTRODUCTION

The achievements of Kerala in the field of health are well documented. The state has the lowest infant and child mortality as well as the highest life expectancy among all Indian states. The overall improvement in health is also reflected in the nutritional status of children. Severe malnutrition has almost disappeared. The lowest rates of underweight and anemia among children are now recorded in Kerala.

These achievements have not been uniform across all sections of society. For further improvements to occur, there is need for targeted interventions aimed at the needy sections of society. There is no reliable data regarding the differentials of nutritional status across socio-economic classes in Kerala. Hemoglobin values, rather than prevalence of anemia in different classes, along with anthropometry would be the ideal measure for this.

Schools in Kerala reflect the socio-economic divide more than any other institution. The well-off sections send their children to private unaided schools while the rest depend on government and private aided schools. Children studying in the unaided private schools are expected to be well nourished and their growth and hemoglobin levels are likely to be the maximum attainable in the population. Comparison of growth and hemoglobin levels of the children from the aided and government schools, as well as those from backward areas like the coastal belt and urban slums with those in the unaided private schools will help to quantify the deficit in the former and will be of immense help in planning nutrition supplementation or any other type of intervention.

Most Government and aided schools in the state have a mid-day meal programme in operation. In each school only a proportion of children enrol as beneficieries. The efficacy of the mid-day meal programme in prevention of growth retardation and anemia is also worth looking into.

REVIEW OF LITERATURE

Adequate food and nutrition are essential for proper growth and physical development to ensure optimal work capacity, normal reproductive performance, adequate immune reactions and resistance to infections. Inadequate diet may produce severe forms of malnutrition in children. The most important being (1) protein–energy malnutrition

(PEM) (2) nutritional anemia (3) vitamin A deficiency and (4) Iodine deficiency disorders.

India has the highest prevalence (and largest share) of malnourished children, low birth weight babies and anemia levels amongst children in the world. Various government schemes set up to combat these problems have not had the expected impact in reducing malnutrition or micronutrient deficiencies[1].

Assessment of nutritional status by Anthropometry

Anthropometry is the measurement of the human body. It is a quantitative method and is highly sensitive to nutritional status, especially among children. There are different types of measurements[2].

1. Height for age

Low height-for-age index identifies past undernutrition or chronic malnutrition. It cannot measure short-term changes in malnutrition. For children below 2 years of age, the term is length-for-age; above 2 years of age, the index is referred to as height-for-age. Deficit in length-for-age or height-for-age is referred to as stunting.

2. Weight-for-age

Low weight-for-age index identifies the condition of being underweight, for a specific age. The advantage of this index is that it reflects both past (chronic) and/or present (acute) undernutrition, although it is unable to distinguish between the two.

3. Weight-for-height

Low weight-for-height helps to identify children suffering from current or acute undernutrition or wasting and is useful when exact ages are difficult to determine. Weight-for-length (in children under 2 years of age) or weight-for-height (in children over 2 years of age) is appropriate for examining short-term effects such as seasonal changes in food supply or short-term nutritional stress brought about by illness.

The above three indices are used to identify three nutritional conditions: underweight, stunting and wasting, respectively.

Underweight: Underweight, based on weight-for-age, is a composite measure of stunting and wasting and is recommended as the indicator to assess changes in the magnitude of malnutrition over time. There is relation between prevalence of underweight and several national factors such as gross national product, infant mortality rate, energy intake per capita, female education, governmental social support, child population, food sources of energy, distribution of income, access to safe water, female literacy rate and region[3].

Stunting: Low length-for-age, stemming from a slowing in the growth of the fetus and the child and resulting in a failure to achieve expected length as compared to a healthy, well nourished child of the same age, is a sign of stunting. Stunting is an indicator of past growth failure. It is associated with a number of long-term factors including chronic insufficient protein and energy intake, frequent infection, sustained inappropriate feeding practices and poverty[4]. In children over 2 years of age, the effects of these long-term factors may not be reversible. Data on prevalence of stunting in a community may be used in problem analysis in designing interventions. Information on stunting for individual children is useful clinically as an aid to diagnosis. Stunting, based on height for- age, can be used for evaluation purposes but is not recommended for monitoring, as it does not change in the short term such as 6 - 12 months.

Wasting: Wasting is the result of the weight falling significantly below the weight expected of a child of the same length or height. Wasting indicates current or acute malnutrition resulting from failure to gain weight or actual weight loss. Causes include inadequate food intake, incorrect feeding practices, disease, and infection or, more frequently, a combination of these factors. Wasting in individual children and population groups can change rapidly and shows marked seasonal patterns associated with changes in food availability or disease prevalence to which it is very sensitive.

4. Body mass index (BMI): Is calculated by the formula

BMI =Weight [in kilograms] / (Height in meters)^2

In children and teens, body mass index is used to assess underweight, overweight, and obesity. Children's body fatness changes over the years as they grow. Also, girls and boys differ in their body fatness as they mature. This is why BMI for children, also referred to as BMI-for-age, is gender and age specific[5,6]. BMI-for-age is plotted on gender specific growth charts. These charts are used for children and teens 2 – 20 years of age.

5. Circumferences: (e.g. head, arm, waist, hip) Brain growth in 1st 3 years closely related to ***head circumference***. ***Mid upper arm circumference (MUAC)*** reflects the arm muscle mass and is the most widely used in older children. It is relatively easy to measure and a good predictor of immediate risk of death in the severely malnourished. It is used for rapid screening of acute malnutrition from the 6-59 month age range (MUAC overestimates rates of malnutrition in the 6-12 month age group). MUAC can be used for screening in emergency situations but is not typically used for evaluation purposes. MUAC is recommended for assessing acute adult undernutrition and for estimating prevalence of undernutrition at the population level.

Comparison of Anthropometric Data to Reference Standards

The reference standards most commonly used to standardize measurements were developed by the US National Center for Health Statistics (NCHS) and are recommended for international use by the World Health Organization. The reference population chosen by NCHS was a statistically valid random population of healthy infants and children[7]. Questions have frequently been raised about the validity of the US-based NCHS reference standards for populations from other ethnic backgrounds. Available evidence suggests that until the age of approximately 10 years, children from well-nourished and healthy families throughout the world grow at approximately the same rate and attain the same height and weight as children from industrialized countries. The NCHS/WHO reference standards are available for children up to 18 years old but are most accurate when limited to use with children up to the age of 10 years.

References are used to standardize a child's measurement by comparing the child's measurement with the median or average measure for children at the same age and sex. Taking age and sex into consideration, differences in measurements can be expressed in a number of ways:

1. Standard deviation units, or Z-scores

The Z-score or standard deviation unit (SD) is defined as the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population.

Z-scores are more commonly used by the international nutrition community because they offer two major advantages. First, using Z-scores allows us to identify a fixed point in the distributions of different indices and across different ages. For all indices for all ages, 2.28% of the reference population, lie below a cut-off of -2 Z-scores. The second major advantage of using Z-scores is that useful summary statistics can be calculated from them. The approach allows the mean and standard deviation to be calculated for the Z-scores for a group of children. The Z-score application is considered the simplest way of describing the reference population and making comparisons to it.

2. Percentage of the median

The percentage of the median is defined as the ratio of a measured or observed value in the individual to the median value of the reference data for the same age or height for the specific sex, expressed as a percentage. The median is the value at exactly the midpoint between the largest and smallest. If a child's measurement is exactly the same as the median of the reference population we say that they are 100% of the median.

3. Percentiles

The percentile is the rank position of an individual on a given reference distribution, stated in terms of what percentage of the group the individual equals or exceeds.

Use of cut-offs

The use of a cut-off enables the different individual measurements to be converted into prevalence statistics. Cut-offs are also used for identifying those children suffering from or at a higher risk of adverse outcomes. The most commonly used cut-off with Z-scores is -2 standard deviations, irrespective of the indicator used. This means children with a Z-score for underweight, stunting or wasting, below -2 SD are considered malnourished. For example, a child with a Z-score for height-for-age of -2.56 is considered stunted, whereas a child with a Z-score of -1.78 is not classified as stunted. In the reference population, by definition, 2.28% of the children would be below -2 SD and 0.13% would be below -3 SD (a cut-off reflective of a severe condition). In some cases, the cut-off for defining malnutrition used is -1 SD (e.g. in Latin America). In the reference or healthy population, 15.8% would be below a cut-off of -1 SD. The use of -1 SD is generally discouraged as a cut-off due to the large percentage of healthy children normally falling below this cut-off.

A comparison of cutoffs for percent of median and Z-scores illustrates the following:

90% = -1 Z-score

80% = -2 Z-score

70% = -3 Z-score (approx.)

60% = -4 Z-score (approx.)

Malnutrition Classification Systems[8]

The most widely used system is World Health Organization (WHO) classification based on Z-scores. The Road-to-Health (RTH) system is typically seen in clinic-based growth monitoring systems. The Gomez system was widely used in the 1960s and 1970s, but is only used in a few countries now. In India, the Indian Academy of Pediatrics (IAP) classification is widely used. An analysis of prevalence elicits different results from different systems. These results would not be directly comparable. The difference is especially broad at the severe malnutrition cut-off between the WHO method (Z-scores) and percent of median methods. At 60% of the median, the closest corresponding Z-score is –4. Mild, moderate and severe are different in each of the classification systems listed below. It is important to use the same system to analyze and present data. The RTH and Gomez classification systems typically use weight-for-age.

WHO system

< -1 to > -2 Z-score	mild
< -2 to > -3 Z-score	moderate
< -3 Z-score	severe

RTH system

> 80% of median	normal
60% - < 80% of median	mild-to-moderate
< 60% of median	severe

Gomez system

> 90% of median	normal
75% - < 90% of median	mild
60% - < 75% of median	moderate
< 60% of median	severe

IAP classification of Nutritional Status

Weight as Percentage of NCHS median

Normal	> 80%
Grade I	71-80%
Grade II	61-71%
Grade III	51-60%
Grade IV	< 50%

Detection of Anemia

Anemia occurs when the total volume of red blood cells (and/or the amount of hemoglobin in these cells) is reduced below normal values, as defined by healthy populations. Anemia results from one or more of the following processes: defective red cell production, increased red cell destruction, or blood loss. There are often multiple causes for anemia. Although iron deficiency is the most common cause of anemia, especially among younger children and women of child-bearing age, other nutrient deficiencies, such as folate and vitamin B12, can also contribute to anemia. Iron deficiency is the commonest nutritional deficiency in the developing and developed countries. About 3.8 billion people all over the world have been estimated to have Iron deficiency anemia[9].

The World Health Organization, over different periods of time has set different standards for the definition of anemia. Based on research, it was recommended by WHO in 1998, that anemia is said to exist if the hemoglobin went below the levels shown in the table below[10].

WHO cut-off criteria for anemia in people living at sea level

Age group	Hemoglobin	MCHC
Children 6 months to 5 years	11 g /dl	33
Children 5 years to 11 years	11.5 g /dl	34
Children 12 years to 13 years	12 g /dl	36
Adult female(non pregnant)	12 g /dl	36
Adult female (pregnant)	11 g /dl	33
Adult male	13 g /dl	39

Methods of Hemoglobin Estimation

Major methods of detecting anemia can be divided into qualitative and quantitative methods. Quantitative methods are obviously more accurate and precise. Among the quantitative methods, technologies that require dilution of blood are more complex and, therefore, more subject to error. The major methods of detection are listed below[11].

Non-Dilutional (No Pre-Mixing Of Blood With Chemicals)

Using Lysed blood

- Filter paper method
- Copper Sulfate
- Hematocrit/centrifuge
- Grey wedge/BMS Hemoglobinometer
- HemoCue (lysis is automatic in the method)

Dilutional (Blood Is Mixed With Chemicals)

Accurately measured amounts of whole blood are mixed with chemicals that produce a new compound. Color intensity of the new compound is proportional to hemoglobin concentration.

This color intensity of the compounds can be measured two ways:

- *Visual Color Match*
    - Sahli-hydrochloric acid - acid hematin
- *Photoelectric Color Match*
    - Cyanmethemoglobin - Drabkin's solution
    - Ammonia - oxyhemoglobin
- Photometry/colorimetry
- Spectrophotometry

For estimation of blood hemoglobin in field conditions, filter paper and copper sulfate methods have been used in the past; but these have low sensitivity and specificity. At present the methods usually employed in surveys are the HemoCue method and Cyanmethemoglobin method. The latter remains the gold standard.

HemoCue method:

In the HemoCue method, whole blood is converted to azide methemoglobin in a disposable, chemically treated cuvette and then measured photometrically at a specified wavelength 565nm [12]. The hemoglobin value is displayed digitally. It is useful for surveys where high accuracy is important. The blood specimen needs no processing. and the instrument is portable. Results are available in less than 45 seconds and are read directly without any calculation. Very little user training is required. It has a sensitivity of 85% in field conditions and approaches 100% in controlled laboratory settings. The specificity is 94%.

A recent study has found that HemoCue method overestimated the hemoglobin when compared to the standard cyanmethemoglobin method. It has been suggested by the authors that in areas where cyanmethemoglobin method cannot be used, HemoCue method may be used after applying a correction factor[13].

Cyanmethemoglobin method [14]

To accurately measure hemoglobin, photoelectric devices are used to assess the amount of light absorbed by a blood sample. When a colored solution is illuminated with visible light, certain wavelengths of light will be absorbed while others will be transmitted. By measuring the amount of light absorbed, one can measure the concentration of a substance in the colored solution. The hemoglobin level is derived by comparing absorbance of the sample to known standards. Cyanmethemoglobin and oxyhemoglobin are the two compounds most commonly used for spectrophotometric and photometric/colorimetric measurements. The absorbance can be measured by photoelectric colorimeters or spectrophotometers. The cyanmethemoglobin method is the international standard for hemoglobin determination, as stable reference solutions are available for calibration. The method is highly accurate and the results are objectively quantified. The technique requires extremely accurate measurements and sophisticated equipment is necessary. Also needed is a reliable, stable supply of electricity.

Anthropometric studies in Indian children

The National Nutrition Monitoring Bureau (NNMB) has been collecting anthropometric data of Indian children periodically from different states. The original data have subsequently been re-tabulated by the WHO so as to increase comparability and ensure the use of uniform norms [15]. The first such survey was undertaken during the years 1974-79 and the latest in 1998-99.

The data is available at http://www.who.int/nutgrowthdb/p-child_pdf/ind.pdf.

According to these indicators, the prevalence of undernutrition in India is still considerably higher than in the average African country and also slightly above the South Asian average.

However, there have been improvements over time. The proportion of young children who are abnormally short and underweight for their age have declined considerably since the seventies and the proportion of extremely stunted (Height for age < -3SD) children in India has dropped from about 50 to 23 per cent.

Another encouraging finding is that the "conventional" notion that female children are at systematic disadvantage vis-à-vis male children is not supported by the anthropometric data.

The pooled data for India is shown in the table below.

Year	**Proportion of children < 5 yrs (%)**		
	Underweight	**Stunting**	**Wasting**
1974-79	71.3	72.3	18.2
1988-90	63.9	62.1	19.2
1991-92	61.0	61.2	18.9
1995-96	49.2	56.5	20.0
1996-97	45.4	42.6	17.2
1998-99	46.7	45.9	15.7

There are also worrying aspects to this report. The proportion children with unduly low height and weight for their age have increased, while having declined more or less consistently for more than two decades, in the late 1990s. It is too early to say whether this is an incidental statistical phenomenon or a true break in the previous trend. Also discouraging is that the developments for India as a whole look favorable; there are states where progress has been considerably slower[15].

India's first National Family Health Survey (NFHS) was conducted in 1992–93 under the auspices of the Ministry of Health and Family Welfare. The survey provides national and state-level estimates of fertility, infant and child mortality, family planning practice, maternal and child health, and the utilization of services available to mothers and children. Anthropometric data for children below 5 years is included in the survey[16]. This was followed up by the second NFHS conducted in 1998-99, which provides information on fertility, mortality, family planning and important aspects of nutrition, health and health care[17]. The survey collected information from a nationally representative sample of more than 90,000 ever-married women of age 15 to 49.

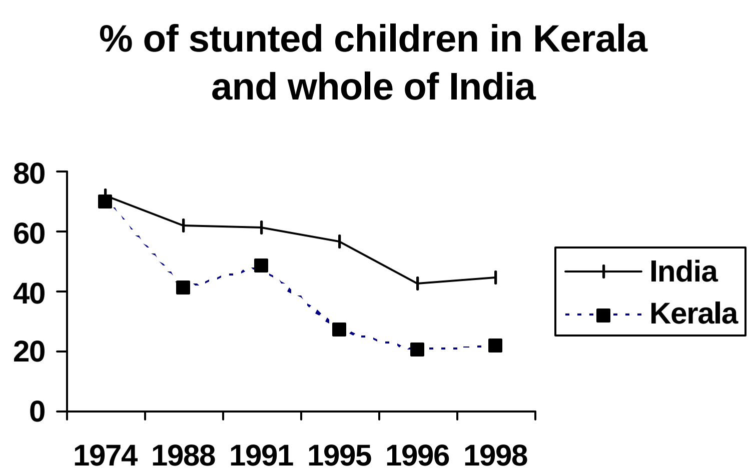
A summary of anthropometric data in the two surveys for preschool children is shown in the table below

Group	**Proportion of children < 5 yrs (%)**		
	Underweight	**Stunting**	**Wasting**
NFHS-1 1992	54	52	17.5
NFHS-2 1998	47	45.5	15.5

In addition to these two sources (NNMB and NFHS), there have been several smaller studies looking at nutritional status by anthropometry at the regional and local levels[18-29].

The situation in Kerala

In both the NNMB and NFHS data, Kerala has the lowest prevalence of underweight, stunting and wasting among the Indian states. Kerala started diverging from the rest of India in the mid seventies and the fall in the rate of undernutrition has been sharper since then as shown by the NNMB data (see figure below – calculated from NNMB data)



As part of a study to evaluate the impact of school lunches on the nutritional status of children in Kerala an anthropometric study was done in 3747 primary school children in three districts of Kerala. The mean weight of 9 year old girls and boys were 19.5 kg and 20.1 kg working out to 68.8% and 71.5% of NCHS median respectively. These figures provide a baseline for measuring the secular trend in heights and weights over the subsequent years[30].

Anemia in Indian children

Anemia is extremely common in Indian children. According to the National Family Health Survey (NFHS-2), overall, nearly three-quarters (74 percent) of the children have some level of anemia, including 23 percent who are mildly anemic (10.0–10.9 g/dl), 46 percent who are moderately anemic (7.0–9.9 g/dl), and 5 percent who are severely anemic (less than 7.0 g/dl). Notably, a much larger proportion of children than women are anemic and the difference is particularly pronounced in the case of moderate to severe anemia[17].

Many regional and local studies have estimated the prevalence of anemia to be high among Indian children. Some of the recent studies are shown in the table below.

Year	Group studied	Prevalence %	Reference
1996	Scheduled caste children 1 – 2 yrs in Punjab	73.3	31
1996	Scheduled caste children 4-5 yrs in Punjab	37.8	31
1997	Rural primary school children - Maharashtra	32.5	32
1998	Urban school children of Punjab	51.5	33
2000	Tribal schoolchildren - Madhya Pradesh	30.3% severe anemia	34
2000	Pre-school children in Kerala	11.4	35
2001	Adolescent girls (10-18 yrs) Rural Meerut	34.5	36
2003	School children of urban slums in Delhi	41.8	37

In the NFHS-2 the prevalence of anemia in children between 6-35 months was the lowest in Kerala among the major Indian states, though still high at 43.9% [17]. Another study done in anganwadies of the state, around the same time however reported anemia in only 11.4% of the children[35]. It seems paradoxical that the former used the

HemoCue method and the latter the cyanmethemoglobin method since it has been shown that the HemoCue method overestimates hemoglobin values when compared to the standard Cyanmethemoglobin method.

The National Nutritional Anemia Control Program (NNACP) in India, implemented through the Primary Health Centers and its subcenters, aims at decreasing the prevalence and incidence of anemia. The beneficiaries are children in the 1-5 age group and pregnant and nursing mothers. It focuses on three vital strategies: promotion of regular consumption of foods rich in iron, provisions of iron and folate supplements in the form of tablets to the high risk groups, and identification and treatment of severely anemic cases. Preschool children (ages 1-5 years) are recommended to take one small tablet per day for 100 days every year. The pediatric tablets contain 20 mg iron and 100 mg folic acid[38].

The total cost of providing iron supplementation through the PHC was estimated at Rs.43,800. The costs included the proportionate cost of the building, workers' salary and the cost of the supplements. The cost per adult beneficiary was Rs. 3.60 and for pediatric beneficiary Rs. 2.90. The overall cost of providing iron and folic acid supplements to the "at risk" population was estimated as Rs 4.40 per beneficiary per year[39].

Schools in Kerala

Kerala has an extensive network of schools with universal enrolment. There are mainly three types of schools depending o the management.

1. Government schools
2. Aided schools: These are Government aided but privately managed. The salary of the teachers is fully met by the Government.
3. Unaided private schools

In each category there are schools following the State syllabus and those following the CBSE syllabus.

Over the years schools have come to reflect the socio-economic class divisions in Kerala society. The poor people tend to send their children to Government and Aided schools. The well to do and even the aspiring middle class especially in urban areas tend to favor the unaided private schools, which are fast growing in number. Almost all of the latter have English as the medium of instruction. The enrolment in various types of schools is shown below[40].

Enrolment in Class 1 (2002-03)

Type of school	Enrolment	%
Government	157527	32.0
Aided private	269610	54.8
Unaided private	65178	13.2
Total	492315	100.0

School Mid- Day Meal Program

The National Programme of Nutritional Support to Primary Education commonly known as Mid Day Meals Scheme was launched in August, 1995 by the Govt of India. The success of the Tamil Nadu’s "Nutritious Meal Programme” as well as the comfortable food stock position in the country led to the formulation of the national programme.

The program is intended to give a boost to universalisation of Primary Education by increasing enrolment, retention and attendance and simultaneously impacting upon nutritional status of students in primary classes. All students of primary classes (I-V) in the Government, Local Body and Government aided schools in the country are being covered in all States/UTs. Private unaided schools and Non-Formal Education Centres are not covered under the programme.

Cent percent Central assistance is being reimbursed for meeting the costs of food-grains (wheat and rice) supplied free of cost by Food Corporation of India and transportation charges to the District Authorities for movement of food-grains from FCI godowns to the schools are re-imbursed. Food-grains are allocated at the rate of 100 gram per child per school day where cooked / processed hot meal is being served and 3 kg per student per month subject to a minimum attendance of 80% by the students where food-grains are being distributed. The expenditure on kitchen sheds and labor charges is to be met from the funds available for works and employment generation under Poverty Alleviation Schemes (JRY/NRY) of the Ministry of Rural Areas and Employment and the Ministry of Urban Affairs.

50,170,850 children are covered under the scheme as on July 2003. At present only 5 States, namely, Gujarat, Kerala, Orissa, Tamil Nadu, Madhya Pradesh (174 tribal blocks) and Union Territory of Pondicherry are providing cooked meal. The remaining States / UTs are distributing food-grains (wheat / rice)[41].

The Mid-day meal has been most extensive and successful in Tamil Nadu. The major State Scheme of Nutritious Meals Program called Puratchi Thalaivar MGR Nutritious Meal Program was introduced from 1-7-1982, in Child Welfare Centers in rural areas for pre-school children in the age group of 2 to 5 years and for primary school children of 5 to 9 years of age (studying in classes 1-5). Subsequently, this scheme was extended to the nutritious meal centers in urban areas and to the school students of 10 to 15 years of age. Old Age Pensioners are also benefited under this scheme. Besides 100 grams of rice, 15 grams of Dhal and 1 gram of oil, one boiled egg is supplied to each child per week. There is evidence that the program has impacted favorably on child growth and survival in the last two decades[42].

OBJECTIVES OF THE STUDY

6. To measure blood Hemoglobin and anthropometric parameters in children studying in different types of schools and in disadvantaged areas of Kozhikode district.

7. To identify the type of anemia when present by peripheral smear examination.

8. To compare the hemoglobin values and anthropmetric parameters, so as to calculate the nutritional deficit in the disadvantaged populations

9. To assess the efficacy of mid-day meal scheme in the schools in preventing growth retardation and anemia.

10. To recommend measures for correction of the nutritional deficit in these populations

SUBJECTS AND METHODS

Subjects

862 children (457 boys and 405 girls) studying in the 4th standard from the following categories of schools in Kozhikode district were studied.

Category	Schools	No studied
Urban aided private school	Malabar Christian College LP School	50
	B.E.M Girl’s L P School	65
Urban unaided private school	Hilltop Public School	92
Urban government School	Medical College Campus Govt HS	110
Rural unaided private school	Navjyothi School, Kunnamangalam	88
Rural aided prvate school	Poyilkavu A.U.P.S, Quilandy	53
	A.U.P.S, Koozhakode	25
Rural government school	Govt U.P School, Chathamangalam	44
	Govt U.P School, Vellannur	16
School in Coastal area	Govt Fisheries UP School, Vellayil	42
School near Urban slum	M.M.L.P School , Parappil	277
Total	***11 schools***	***862***

The schools have been further categorized into three classes for purpose of analysis, namely

4. Upper class schools (Urban and rural Unaided schools)
5. Ordinary schools (Government and Aided schools)
6. Backward area schools (Schools in coastal and slum areas)

Methods

For each child, the date of birth, occupation of Guardian and Mid-day meal beneficiary status was obtained from the school register and recorded. Clinical examination was done particularly for evidence of nutritional deficiency, namely the presence or absence of Conjunctival xerosis, Bitot’s spots, Angular stomatitis and Phrynoderma.

Nutritional Anthropometry

Height: was measured using a measuring tape. The tape was fixed to the wall vertically, using cellophane tape, and height measured by making the child stand with heels in apposition with the wall taking care that there is no bending of the knees.

Weight: was measured using an electronic weighing machine having 100gm accuracy.

Mid upperarm circumference: The circumference of upperarm at a point midway between acromion and olecranon process was taken using a separate measuring tape

Body Mass Index was calculated from Height and weight.

Blood Examination

Blood collection: Blood was collected from each child by finger prick method using disposable lancets.

Hemoglobin estimation: 20 microliters of blood was withdrawn using fixed volume micropipette and transferred to 5 ml Drabkin reagent taken in 75X 10 mm glass test tubes. The absorbance of Cyanmethemoglobin was measured within 2 hours using photoelectric colorimeter at 540 nm. The readings were converted into actual hemoglobin concentration after checking the absorbance of the standard. The hemoglobin concentration was expressed in g/dL.

Peripheral smear was prepared and stained with Leishman stain. RBC morphology was studied and differential WBC count was done in each case.

School lunch Program

Discussion was held with the teachers regarding the type of food served, availability of supplies and the number of days the meal was provided. The lunch was observed in five of the nine schools where the program was in place.

Analysis

The data was entered as Excel files and analysed by EPIINFO statistical software. The NCHS/WHO reference standards were used to define underweight and stunting[7]. The cut-off used to define anemia was 11.5 gm as recommended by WHO in 1998 [10]

RESULTS

The basic data is presented in the following tables and figures.

Anthoropmetry

Table 1: Height and Weight of children in different types of schools

Table 2: BMI and Mid-arm circumference of children in different types of schools

Table 3: Height (cms) of girls and boys in different types of schools

Table 4: Weight (Kgs) of girls and boys in different types of schools

Table 5: Height (cms) and Weight (kg) according to occupation of parents

Table 6: Height and weight – difference according to gender in different classes of schools

Blood Examination

School lunch evaluation

Mid-day meal program is being conducted in all schools other than the unaided ones. In six of the schools *Kanji* (rice gruel) was served with Green gram. In three others the menu was *Choru* (solid rice) with Green gram. In one school pickle was served regularly. The supply of grain and pulses were on the whole regular with only two rural schools reporting irregular delivery resulting in the stoppage of the program for a month in the year. The burden of organizing the meal and supervision fell totally on the teachers.

On the whole, the menu was invariable and monotonous. The children were in no sense seen to relish the food. Financial constraints prevented the teachers from organizing more varied and interesting fare,

Table 1
Height and Weight of children in different types of schools

Type of school	n	Height (cms)			Weight (kg)		
		Mean	**95% CI**	**Median**	**Mean**	**95% CI**	**Median**
9 year old children							
Urban Govt	89	128	126.9-129.1	128	24.2	23.3-25.1	23.8
Urban Aided	107	128.4	127.3-129.5	128	24.0	23.3-24.7	23.8
Urban unaided	50	132.3	130.6-134.0	131.75	29.7	27.3-32.1	27.4
Slum area	127	125.8	124.8-126.8	126	22.4	21.8-23.0	21.9
Rural Govt	47	127.3	125.7-128.9	126	22.9	21.9-23.9	22.5
Rural Aided	66	128.5	127.3-129.7	128	23.4	22.5-24.3	22.7
Rural Unaided	47	131.4	129.9-132.9	131	27.0	25.5-28.5	26.1
Coastal area	34	126.5	124.8-128.2	125.5	22.0	21.1-22.9	22.1
Total	567	128.1	127.5-128.5	128	24.2	23.8-24.6	23.3
10 year old children							
Urban Govt	19	130.7	128.4-133.0	130	24.8	22.6-27.0	24.2
Urban Aided	8	130.4	126.3-134.5	129.75	24.2	21.5-26.9	24.2
Urban unaided	38	135.5	133.7-137.3	135	30.6	28.5-32.7	29.1
Slum area	114	128.7	127.7-129.7	129	23.9	23.1-24.7	23.2
Rural Govt	8	129.6	125.4-133.8	131	22.8	21.8-23.8	23.3
Rural Aided	10	127.9	124.5-131.3	128.5	22.4	20.4-24.4	22.9
Rural Unaided	40	135.5	133.6-137.4	135.5	28.2	26.5-29.9	26.9
Coastal area	5	130.1	123.5-136.7	127	23.1	20.2-26.0	22.8
All	242	131.1	130.3-131.9	131	25.6	24.9-26.3	24.3

Table 2
BMI and Mid-arm circumference of children in different types of schools

Type of school	n	Body mass index			Mid-arm circumference		
		Mean	**95% CI**	**Median**	**Mean**	**95% CI**	**Median**
9 year old children							
Urban Govt	89	14.7	14.3-15.1	14.4	17.9	17.5-18.3	17.5
Urban Aided	107	14.5	14.2-14.8	14.2	17.7	17.3-18.1	17.5
Urban unaided	50	16.8	15.8-17.8	15.7	19.9	18.9-20.9	18.75
Slum area	127	14.1	13.9-14.3	13.8	16.7	16.4-17.0	16.5
Rural Govt	47	14.1	13.7-14.5	13.9	16.2	15.8-16.6	16
Rural Aided	66	14.1	13.7-14.5	13.9	17.1	16.7-17.5	17
Rural Unaided	47	15.6	14.9-16.3	15.1	17.9	17.2-18.6	17.5
Coastal area	34	13.7	13.3-14.1	13.6	16.4	16.0-16.8	16
Total	567	14.6	14.5-14.7	14.2	17.4	17.3-17.5	17
10 year old children							
Urban Govt	19	14.4	13.5-15.3	14.3	17.9	16.8-19.0	18.0
Urban Aided	8	14.1	13.1-15.1	13.7	17.8	16.7-18.7	17.5
Urban unaided	38	16.5	15.7-17.3	15.8	19.8	19.0-20.6	18.5
Slum area	114	14.3	14.0-14.6	13.9	16.8	16.5-17.1	16.5
Rural Govt	8	13.6	12.9-14.3	13.4	16.6	15.8-17.4	16.8
Rural Aided	10	13.6	12.9-14.3	13.5	16.6	15.9-17.3	16.5
Rural Unaided	40	15.2	14.6-15.8	14.9	18.0	17.4-18.6	17.3
Coastal area	5	13.6	12.8-14.4	13.8	16.8	16.1-17.5	17.0
All	242	14.8	14.5-15.1	14.2	17.6	17.3-17.9	17.0

Table 3
Height (cms) of girls and boys in different types of schools

Type of school	Girls				Boys			
	n	**Mean**	**Median**	**As % of NCHS Median**	**n**	**Mean**	**Median**	**As % of NCHS Median**
9 year old children								
Urban Govt	46	127.6	128.25	97.0	43	128.4	128	96.8
Urban Aided	59	127.9	127.5	96.4	48	129.0	128.75	97.4
Urban unaided	19	132.1	132	99.8	31	132.3	131.5	99.5
Slum area	63	124.8	125	94.6	64	126.7	126.25	95.5
Rural Govt	26	128.0	127	96.1	21	126.5	125	94.5
Rural Aided	33	128.0	127	96.1	33	129.0	128.5	97.2
Rural Unaided	25	131.1	130	98.3	22	131.7	131.5	99.5
Coastal area	19	126	123.5	93.4	15	127.2	126	95.3
Total	290	127.6	127	96.1	277	128.7	128.5	97.2
10 year old children								
Urban Govt	6	129.25	130.5	94.3	13	131.4	131	95.3
Urban Aided	6	130.7	132.75	96.0	2	129.8	129.8	94.4
Urban unaided	14	134.5	134	96.9	24	136.1	135	98.1
Slum area	47	128.0	127	91.8	67	129.3	129	93.8
Rural Govt	4	129.0	130	94.0	4	130.3	133	96.7
Rural Aided	3	127.5	128	92.6	7	128.1	130.5	94.9
Rural Unaided	14	135.1	135	97.6	26	135.6	136	98.9
Coastal area	3	133.0	133	96.1	2	125.8	125.8	91.5
All	97	130.4	131	94.7	145	131.7	131	95.3

Table 4

Weight (Kgs) of girls and boys in different types of schools

Type of school	Girls				Boys			
	n	Mean	Median	As % of NCHS Median	n	Mean	Median	As % of NCHS Median
9 year old children								
Urban Govt	46	24.0	24.0	84.2	43	24.5	23.8	84.7
Urban Aided	59	24.2	24.2	84.9	48	23.8	23.4	83.3
Urban unaided	19	28.3	26.8	94.0	31	30.6	27.8	98.9
Slum area	63	21.9	21.4	75.1	64	22.9	22.5	80.1
Rural Govt	26	22.6	22.4	78.6	21	23.1	22.5	80.1
Rural Aided	33	23.4	22.1	77.5	33	23.5	23.4	83.3
Rural Unaided	25	27.9	26.6	93.3	22	26.0	24.7	87.9
Coastal area	19	22.1	21.9	76.8	15	21.9	22.2	79.0
Total	290	23.9	23.2	81.4	277	24.4	23.4	83.3
10 year old children								
Urban Govt	6	23.7	24.3	74.8	13	25.3	24.0	76.4
Urban Aided	6	24.6	26.4	81.2	2	22.8	22.8	72.6
Urban unaided	14	30.4	30.7	94.5	24	30.6	28.0	89.2
Slum area	47	23.3	22.6	69.5	67	24.3	23.7	75.5
Rural Govt	4	23.1	23.3	71.7	4	22.5	22.5	71.7
Rural Aided	3	20.7	21.1	64.9	7	23.1	24.2	77.1
Rural Unaided	14	28.4	26.6	81.8	26	28.0	27.3	86.9
Coastal area	3	23.8	24.6	75.7	2	21.9	21.9	69.7
All	97	25.1	23.7	72.9	145	25.9	24.6	78.3

Table 5
Height (cms) and Weight (kg) according to occupation of parents

Type of school	Height				Weight			
	n	Mean	Median	As % of NCHS Median	n	Mean	Median	As % of NCHS Median
9 year old children								
Manual labor	202	126.8	127	96.1	202	22.8	22.2	78.4
Farming	5	124.8	124	93.8	5	20.9	21.1	74.6
Fishing	54	127.2	127.25	96.3	54	23.1	22.6	79.9
Skilled worker	90	128.9	129	97.6	90	24.6	23.9	84.5
Self employed	85	127.5	127	96.1	85	23.3	23.1	81.6
Factory work	4	131.1	129.5	97.8	4	22.7	22.4	79.2
White collar	51	128.8	128.5	97.2	51	24.6	23.4	82.7
Business	42	131.9	131.5	99.5	42	29.3	27.2	96.1
Executive	8	133.9	134.25	101.6	8	28.9	28.0	98.9
Professional	12	133.0	131.5	99.5	12	31.6	26.9	95.1
NRI	9	129.7	130.5	98.7	9	26.5	25.2	89.0
10 year old children								
Manual labor	102	128.7	129	93.5	102	23.6	23.3	70.7
Farming	1	129.0	129	93.5	1	24.7	24.7	75.0
Fishing	15	129.1	129.5	93.9	15	23.4	22.9	69.5
Skilled worker	21	131.5	131	95.0	21	25.1	24.5	74.5
Self employed	25	129.9	129	93.5	25	24.7	23.8	72.2
Factory work	5	132.5	135	97.9	5	24.2	26.3	79.8
White collar	14	135.2	136.5	99.0	14	28.2	26.8	81.3
Business	34	136.1	135	97.9	34	30.6	29.1	88.3
Executive	2	134.8	134.8	97.8	2	30.8	30.8	93.5
Professional	9	134.8	134	97.2	9	28.7	27.9	84.7
NRI	10	132.6	134.8	97.8	10	28.1	26.2	79.5

Table 6

Height and weight – difference according to gender in different classes of schools

Type of school	n	**Mean height as % of NCHS standard**			**Mean weight as % of NCHS standard**		
		Girls	**Boys**	**p**	**Girls**	**Boys**	**p**
Upper class	180	98.8	99.4	0.34	95.7	98.1	0.51
Ordinary	363	96.3	96.8	0.25	81.9	83.5	0.27
Backward	319	93.2	95.1	0.02	75.1	79.6	0.001

Table 7
Height and weight – difference according School lunch beneficiary status in ordinary and backward area schools

Type of school	n	**Mean height as % of NCHS standard**			**Mean weight as % of NCHS standard**		
		Lunch +	**Lunch -**	**p**	**Lunch +**	**Lunch -**	**p**
Ordinary	363	96.6	96.4	0.65	82.0	85.3	0.07
Backward	319	94.4	94.2	0.8	75.9	81.3	0.0003
Ordinary + Backward	682	95.6	95.2	0.52	79.4	83.0	0.002

Table 8
Secular trend in Mean height and weight from 1976 (Soman & Soman) to 2003 (This study) in 9 year old children

Study	n	Mean Height (% of NCHS Std)		Mean Weight (% of NCHS Std)	
		Girls	Boys	Girls	Boys
Soman& Soman 1976	482	119.7 (90.5)	120.6 (91.2)	19.6 (68.8)	20.1 (71.5)
This study – Backward	319	125.1 (94.6)	126.8 (95.9)	22.0 (77.2)	22.7 (80.8)
This study – Ordinary	363	127.9 (96.7)	128.5 (97.2)	23.7 (83.2)	23.8 (84.7)
This study – Upper class	180	131.5 (99.5)	132.1 (99.9)	28.1 (98.6)	28.7 (102.1)

Table 9
Blood Hemoglobin of children in different types of schools

Type of school		Blood Hemoglobin (g/dl)		
	n	Mean	95% CI	Median
Urban Govt	110	10.8	10.6-11.0	10.9
Urban Aided	115	10.6	10.4-10.8	10.9
Urban unaided	91	12.5	12.2-12.8	12.7
Slum area	277	12.3	12.1-12.5	12.2
Rural Govt	59	11.8	11.6-12.0	11.8
Rural Aided	78	11.8	11.5-12.1	11.8
Rural Unaided	86	12.7	12.5-12.9	12.7
Coastal area	41	10.7	10.4-11.0	10.5
All	857	11.8	11.7-11.9	11.8

Table 10
Blood Hemoglobin of children in different classes of schools

		Blood Hemoglobin		
Class of school	**n**	**Mean**	**95% CI**	**Median**
Upper class	177	12.6	12.4-12.8	12.7
Ordinary	362	11.1	11.0-11.2	10.9
Backward	318	12.1	11.9-12.3	12.2
All	857	11.8	11.7-11.9	11.8

Table 11
Blood Hemoglobin according to occupation of parents

Occupation		**Blood Hemoglobin (g/dl)**		
	n	**Mean**	**95% CI**	**Median**
Manual labor	339	11.9	11.7-12.1	11.8
Farming	7	11.8	11.1-12.5	11.8
Fishing	72	11.3	11.0-11.6	11.4
Skilled worker	113	11.3	11.0-11.6	11.4
Self employed	113	11.4	11.2-11.6	11.4
Factory work	9	12.9	12.1-13.7	12.7
White collar	64	11.8	11.5-12.1	11.8
Business	77	12.8	12.5-13.1	12.7
Executive	10	12.0	10.9-13.1	12.7
Professional	22	12.4	11.8-13.0	12.5
NRI	20	12.2	11.7-12.7	12.7

Table 12
Blood hemoglobin– difference according to gender in different classes of schools

Class of school	Girls		Boys		p
	n	Mean Hb (g/dl)	n	Mean Hb (g/dl)	
Upper class	71	12.6	106	12.6	1.0
Ordinary	185	11.3	177	11.0	0.04
Backward	145	12.1	173	12.1	1.0
All	401	11.8	456	11.8	1.0

Table 13
Blood hemoglobin – difference according School lunch beneficiary status in ordinary and backward area schools

Class of school	n	Lunch +	n	Lunch -	p
Ordinary	289	11.1	73	11.1	1.0
Backward	221	12.0	97	12.3	0.048
Ordinary + Backward	510	11.5	170	11.8	0.02

Table 14
Mean eosinophil % in the peripheral smear of children in different types of schools

Type of school	No	Mean	95% CI	Median
Urban Govt	***110***	5.8	5.2 – 6.4	5
Urban Aided	115	4.7	3.8 – 5.6	3
Urban unaided	91	3.5	2.8 – 4.2	2
Slum area	277	5.4	4.7 – 6.1	4
Rural Govt	59	3.5	2.2 - 4.8	3
Rural Aided	78	3.2	2.3 - 4.1	2
Rural Unaided	86	3.3	2.6 – 4.0	3
Coastal area	41	8.6	6.9 - 10.3	8
Total	***857***	***5.0***	***4.6 – 5.4***	***4***

Fig 1: Height of 9 year olds in different classes of schools

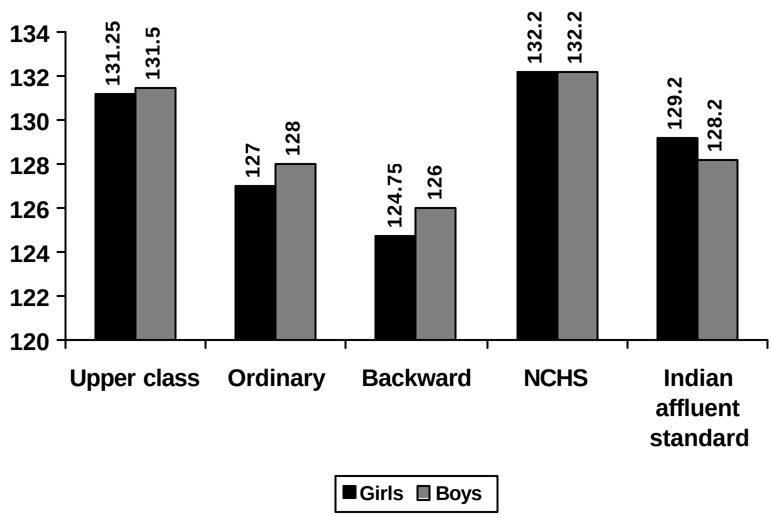


Fig 2: Height of 10 year olds in different classes of schools

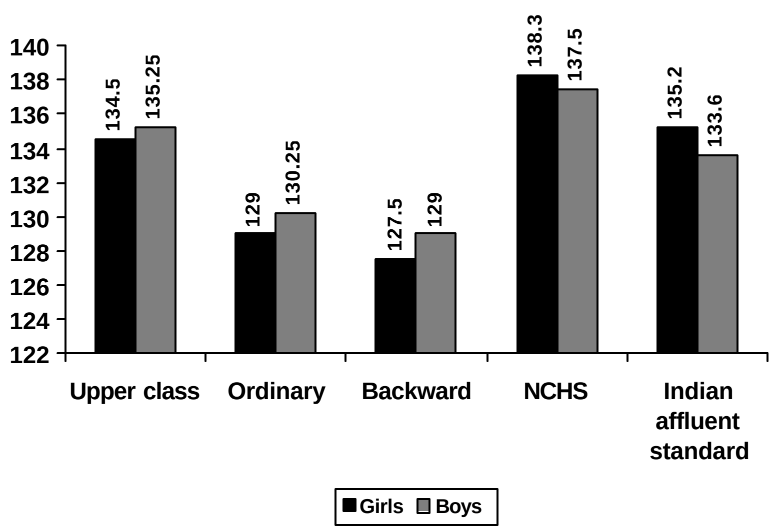


Fig 3: Weight of 9 year olds in different classes of schools

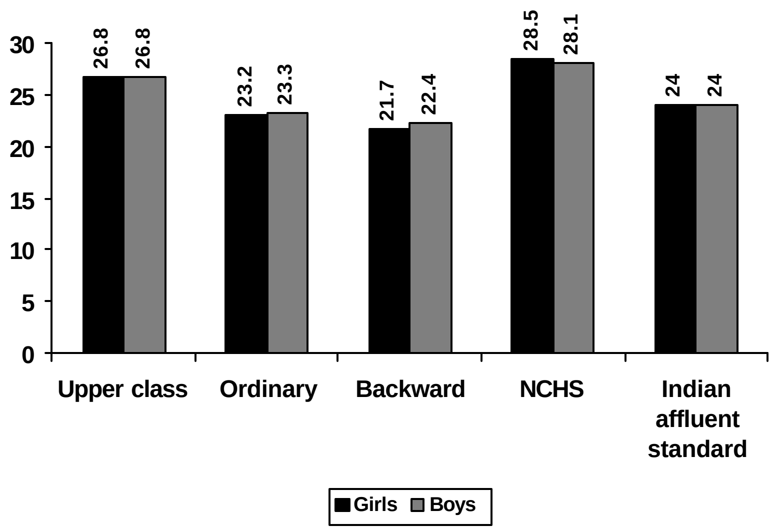


Fig 4: Weight of 10 year olds in different classes of schools

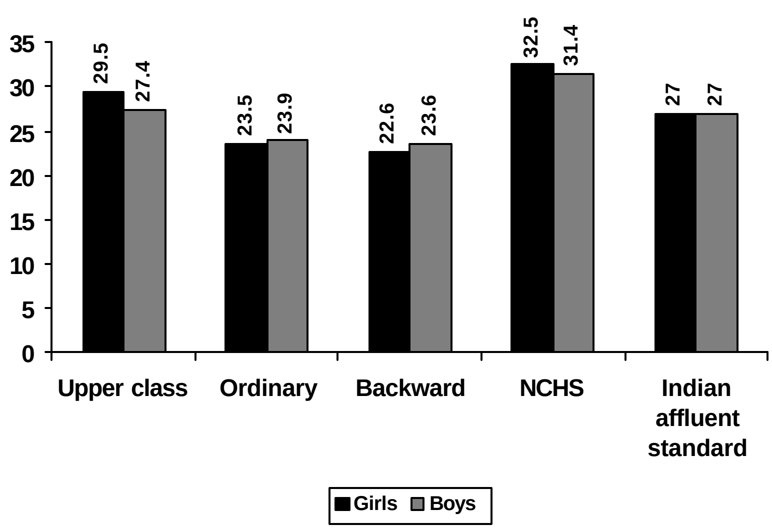


Fig 5: Proportion (%) of stunted children in different classes of schools

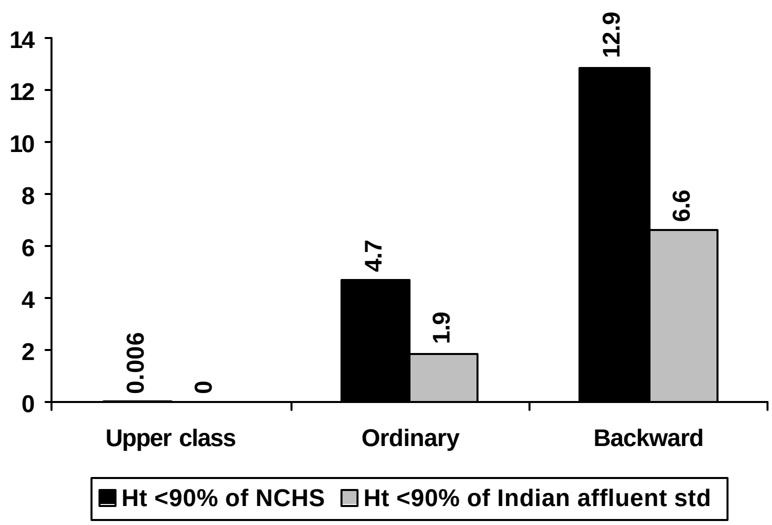


Fig 6: Proportion (%) of Underweight children in different classes of schools

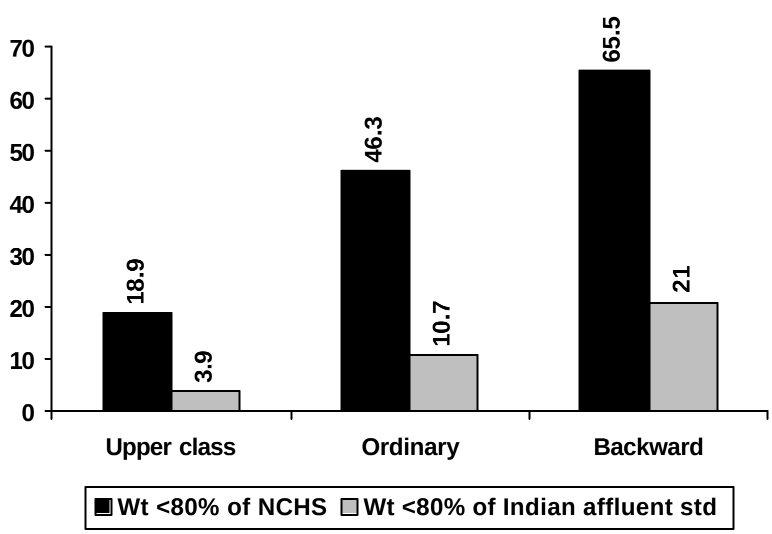


Fig 7: Proportion (%) of grades of undernutrition in different classes of schools (NCHS standards)

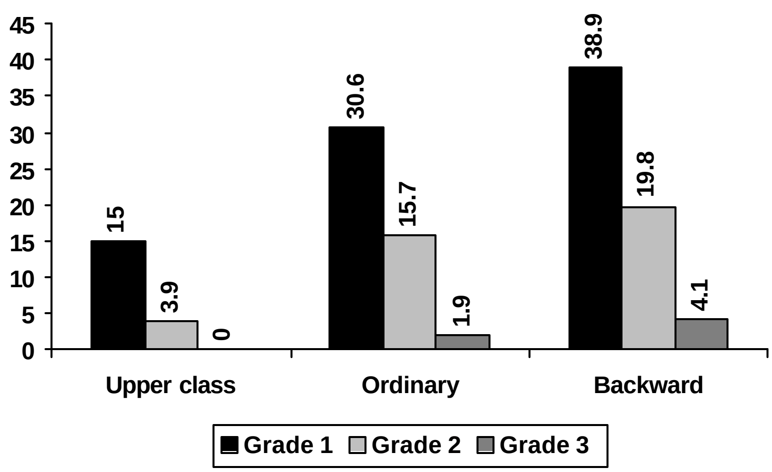


Fig 8: Proportion (%) of Overweight children in different classes of schools

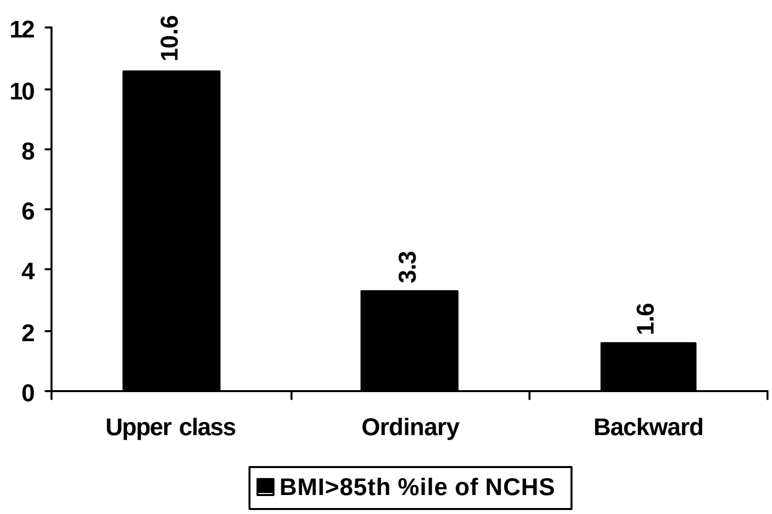


Fig 9: Proportion (%) of anemic children in different types of schools with two cut-offs of 11g & 11.5g

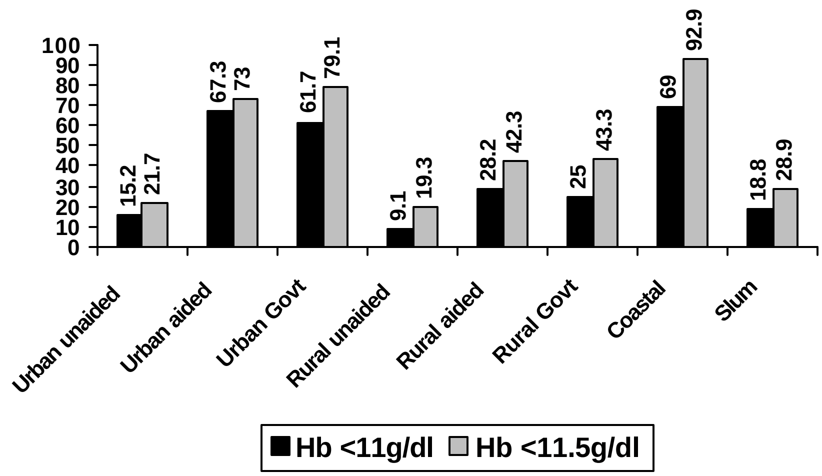


Fig 10: Proportion (%) of grades of anemia in different classes of schools

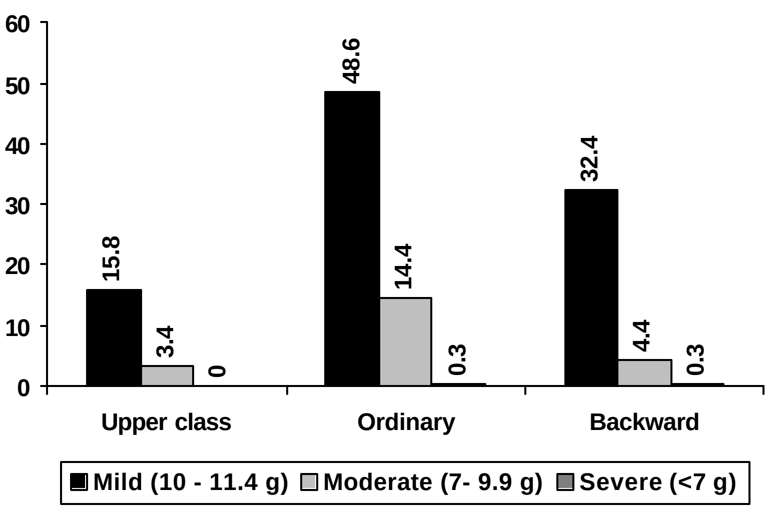
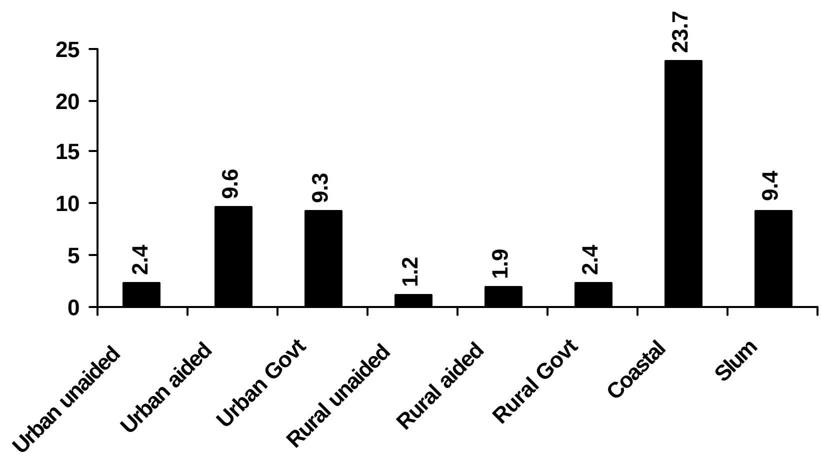


Fig 11: Proportion (%) of children in different types of schools with >10% Eosinophils in the smear



DISCUSSION

The state of Kerala made dramatic progress in all health indicators in the last quarter century. Till 1971, Kerala had the highest population growth rate in India. The birth rate fell from 31 in 1971 to 18 in 2001. Infant mortality fell from 55 to only 13 in the same period.

These changes have been the result of a significant improvement in living conditions. The nutrition status of children also improved remarkably during the period. The NNMB data shows that the proportion of stunted children in 1974 was nearly the same as in the rest of India at 70.2%. In 1998 it was less than half of the all India figure at 21.8% (See figure in the Review section).

Progress in the last quarter century

The current study provides data as to what this means to child growth in absolute terms. Fortunately we have a very reliable dataset from 1976 with which the current figures can be compared[30]. There has been an increase in mean height to the tune of 8.8 cm and 8.2 cm for nine-year-old boys and girls studying in ordinary schools in the state respectively in the last 27 years. Even in schools in the backward areas, there has been an increase in mean height of 6.2 cm and 5.4 cm for boys and girls respectively. This is bound to affect of the eventual height of the adult population as well. The increase in mean weight is 3.7 kg (boys) and 4.1 kg (girls) in ordinary schools and 2.6 kg (boys) and 2.4 kg (girls) in backward area schools.

How much of this increase can be attributed to actual increase in calorie and protein intake is debatable. It could well be that control of childhood infections is the major factor in the increase seen during this period.

Class differentials in nutritional status

The most important aspect of our study is the quantification of class differentials in childhood growth and nutrition status in Kerala society. In a situation where childhood infections – particularly diarrhoeal diseases – have been controlled to a great extent, this would mostly reflect the differentials in energy and protein intake. That the differences between the upper class schools (accounting for 13.2 % of children) and the rest are still considerable is evidence of significant 'chronic hunger' in the majority of the state's children.

A basic premise of the current study was that the growth and nutrition parameters of children studying in the unaided private schools are likely to be the maximum attainable in the population. In other words they are realizing their full genetic potential. This is borne out by the results. Children in the urban unaided schools have height that is not significantly different from the NCHS standards. These children have growth characteristics similar to their counterparts in the United States (see tables 3 and 4).

Agarwal et al studied growth parameters on 12,899 boys and 9,951 girls of affluent class from 8 States of the country. In pooled data, the 50th centile height approached 30-40th centile till 6 1/2 years in boys and up to 10 years in girls, of NCHS standards. Similarly, for weight, they approached 10-20th centile of NCHS standards. They have published growth charts for boys and girls in the age group 0-18 years[43]. Our data show that median height of 9-year-old boys and girls in urban unaided schools are respectively 102.2% and 102.6% and median weight respectively 113.9% and 114% of their median values. These values lie in between the NCHS and the Indian affluent standards proposed by Agarwal et al – but nearer the former than the latter.

Actual deficits in the disadvantaged groups

The differences in median height and weight between children in the upper class schools and the rest are still considerable (Figures 1-4). The actual deficits that children in the ordinary and backward area schools have are shown below.

Parameter	Age	Gender	Deficit compared to upper class school	
			Ordinary school	**Backward school**
Height	9 yr	Male	3.5 cm	5.5 cm
		Female	4.3 cm	6.5 cm
	10 yr	Male	5.0 cm	6.3 cm
		Female	5.5 cm	7.0 cm
Weight	9 yr	Male	3.5 kg	4.4 kg
		Female	3.6 kg	5.1 kg
	10 yr	Male	3.5 kg	3.8 kg
		Female	6.0 kg	6.9 kg

The differences in anthropometric parameters according to parents' occupation are shown in table 5. The categories with no significant reduction from the NCHS standards are businessmen, professionals, executives and Non Resident Indians, who send their children almost exclusively to the unaided schools. The laboring classes who form the vast majority are represented exclusively in the other schools. White-collar employees and skilled workers are represented more in the ordinary schools, but children of some are to be seen in the unaided schools also. The occupational divisions in the society are reflected in the choice of schools, and seem to be the basis of the differences noticed between the categories of schools.

The differences in height and weight according to gender are shown in Table 6. There is no statistical difference between boys and girls in the upper class and ordinary schools. However, girls have significantly lower height and weight compared to boys in the backward schools but the magnitude of difference is not large. Gender discrimination in feeding the girl child would seem to exist only in conditions of extreme deprivation.

There is no significant difference in mean height between those availing the mid-day meal program and those who do not. But the mean weight is significantly higher in the non-participatory group. This is understandable, since it is the relatively better off who would be expected not to enroll as beneficiaries. All the same, it is worth noting that the school lunch in its present form is not making up for energy and protein deficit in full measure.

Stunting, underweight and overweight

The proportion of stunted children is 0 %, 4.7% and 12.9% in the upper class, ordinary and backward area schools respectively (Figure5). Long-term longitudinal growth is thus impaired to a considerable extent in the backward area children, while it is not that big a problem in the children in ordinary schools. The proportion of underweight on the other hand is high in both ordinary and backward area schools (46.3% and 65.5% respectively – Figure 6). Stunting is the result of long-term energy / protein deficiency or the result of other factors including intrauterine events, whereas underweight is the result of more recent energy / protein deficiency. What explains the wide gap between the two in our data is debatable. Has there been a slide back in the past few years in food consumption due to the after effects of factors like falling agricultural incomes and less work days for daily wage earners? It is interesting that pooled NNMB data shows a minor slide back in nutritional parameters in the latter nineties both in Kerala and the whole of India[15]. An alternative explanation is that the NCHS standards for height are too high for Indian children. It is seen that the prevalence of underweight falls to 10.7% in ordinary schools and 21% in backward area schools when Indian affluent median[43] is taken as the standard.

Severe malnutrition (grade 3 underweight) was seen in 4.1 % in the backward area schools, but was very low or absent in others. If the Indian affluent standard is taken as the reference there are no cases of grade 3 underweight even in the backward area schools. Other signs of severe nutritional deficiency like conjunctival xerosis and Bitot's spots (Vitamin A deficiency) were not seen in any of the children studied. This is remarkable; since Soman and Soman saw these in virtually every school they studied in 1976, with rates ranging from 1% to more than 30%. Angular stomatitis was seen in only one child among the 862 studied.

While there has been a marked decline in severe malnutrition, a new problem is emerging among children in Kerala. There is a 10.6% prevalence of overweight among children of upper class schools (Figure 8). Tendency for decline in physical activity and resultant overweight and obesity among children can lead to morbidity in later life. This is an emerging problem that needs attention.

The problem of Anemia

The mean hemoglobin in all the children is 11.8 g/dl (95% CI 11.7-11.9); well above the WHO cut-off for defining anemia in 6-11 year olds. But 44.2% of the children are found to be anemic by the same criterion. This is similar to the NFHS-2 data, which found an anemia prevalence of 43.9%, though this was in pre-school children. Another study in preschoolers around the same period found only 11.4% to be anemic. Comparisons between studies can be problematic because of dfferences in technique and the cut-offs used. The NFHS study used the HemoCue method, which actually overestimates the hemoglobin levels and consequently underestimates anemia prevalence.

The peripheral smear was normal in most cases of anemia. Microcytic hypochromic anemia was the only abnormality found. There were no cases of macrocytic anemia. For this reason, the predominant cause of anemia is presumed to be iron deficiency.

Iron deficiency anemia is the most prevalent nutrition problem worldwide. The prime cause of nutritional anemia is inadequate iron intake and low bioavailability. Children consume less food than do adults and their diet often consist of foods with a low iron content and in which the bioavailability of iron is poor. Anemia during childhood may lead to impaired motor development, decreased growth and appetite and is also associated with poorer performance of the immune system. There is reduced learning capacity and cognitive performance, which may be reversed by iron supplementation[44,45].

Severe anemia (Hb< 7g/dl) was seen to be extremely rare in our study. It was seen in only students (0.2%). Moderate anemia was seen in 8.4 %. Most cases were of mild anemia (34.8%). To what extent mild anemia may affect growth and school performance in school children is unsettled. But the fact remains that a large number of children have hemoglobin values lesser than what is required for the age. This attests to widespread iron deficiency. If the mean hemoglobin of children in the unaided schools (12.6 g/dl) is taken as the gold standard the deficit in the various other types of schools is as follows.

Type of school	Hb Deficit
Urban Govt	1.8 g/dl
Urban Aided	2.0 g/dl
Coastal area	1.9 g/dl
Rural Govt	0.8 g/dl
Rural Aided	0.8 g/dl
Slum area	0.3 g/dl

The largest deficits are seen in the urban ordinary schools and the coastal area. The situation seems to be much better in the rural schools. Surprisingly the urban slum area school shows no significant deficit, despite scoring low on all growth parameters. The reason for this is not clear. It would be interesting to investigate the reasons behind the rural urban difference. Is it low intake of iron rich vegetables by the urban lower middle class that accounts for it? One would expect higher consumption of locally or home grown vegetables in the rural areas and lower consumption in urban areas since vegetables have to be bought from the market.

The hemoglobin levels are more in children of those with higher income occupations like Professionals, Executives Businessmen as expected (table 11). There was not much difference between the other categories. Gender differences were also not significant in the sample as a whole though there was a small but significant difference in the ordinary schools in favor of girls (table 12). Similarly non-beneficiaries of the school lunch significantly higher hemoglobin values compared to the beneficiaries.

Eosinophilia

Prevalence of Eosinophilia is seen to vary according to the type of school (figure 11). It is seen in as much as 23.7% of children in the coastal school. It is also seen to affect nearly ten percent of the children in the urban ordinary and slum schools, while it is not a problem in the urban unaided and rural schools. Eosinophilia could be due to intestinal helminthiasis, filarial or both. If it were due to intestinal helminthiasis, it could be a factor explaining the impairment of growth parameters. But then, the children of rural ordinary schools with similar growth characteristics do not have significant eosinophilia. For this reason, and because the urban sample was from Calicut which is a filarial endemic coastal city, filariasis could be the most probable explanation for the phenomenon.

The way forward

The data presented in this study provides evidence that the vast majority of children in Kerala – studying in the government and aided schools – do not realize their full genetic potential for growth. They are considerably shorter and lighter than their counterparts in the unaided private schools and are likely to become shorter and lighter adults. Nearly half the children are anemic. These problems are even more acute in the disadvantaged groups.

Simply put, the majority of our children need more calories, protein and micronutrients like iron. Steps like giving iron tablets or micronutrient fortification are no answer to the problem in this situation. What they need is more food, which is of nutritive value. School lunch could be an ideal vehicle to achieve this end.

Doubts have been raised about the effectiveness of feeding programs for school-age children who have survived the malnutrition and disease of the younger years of life. At school age, they are relatively less vulnerable to malnutrition than are pre-school children and are, therefore, not considered a high-risk group. Critics of school lunch programs have drawn attention to the inconclusive evidence of its impact. Our data also shows that the school lunch in its present form does not offer additional advantage in terms of growth and prevention of anemia.

The lunch as it is today is designed to prevent severe malnutrition, which it has achieved. It fails as a 'catch-up' device to ensure optimum growth. The menu offered is invariant and monotonous and does not interest the child. There is in general lack of interest on part of the Government, panchayats and the community. The infrastructure and staff support are poor and the whole burden of the program falls on the teachers. Contrast this with Tamil Nadu where in the words of Dreze and Goyal "It was a joy to observe the mid-day meal in Tamil Nadu - a living example of what can be achieved when quality safeguards are in place. Each school had a cooking shed and a paid staff of three: a cook, a helper, and an "organizer" who looks after logistics and accounts.

All of them were women, and we were impressed with their competence and self-confidence. The menu also seemed more nourishing than in Chhattisgarh, Rajasthan or even Karnataka. There is rice and *sambhar* every day, but different vegetables are used over the week and there are regular supplements. The portions are adequate for young children, and everywhere we went, pupils clearly relished the whole affair."[46]

With more political commitment, the mid-day meal program in Kerala can be made a model. The menu can be made more varied with addition of vegetables and eggs to be provided once or twice a week as in Tamil Nadu. The vegetables needed can be grown in the school compounds with the help of children and this can be linked to their curricular activities. The Parent Teacher Associations can be actively associated with the program and unemployed mothers can be recruited to organize the meal and given a nominal stipend. The program can serve as a forum for providing nutrition education to mothers.

All this would need only modest outlay on part of the state government, since grain and pulses are supplied free by the central government. Providing equality of opportunities in education encompasses taking care of the nutritional needs of all children for ensuring optimum growth and preventing learning disabilities. A pro-active role from the Government and community leaders is the need of the hour.

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