CHANGES

The Ministry of Education's School Health and Nutrition Programme (supported by USAID)

BASELINE SURVEY REPORT

(Eastern Province, October 2001)

September 2002

Partnership for Child Development

Contents

Introduction

Education for All (EFA) is an historic commitment to basic education made by the international community in Jomtien, Thailand, in 1990 and reaffirmed at the World Education Forum in Dakar, Senegal, in April 2000. The commitment reflects a vision that all children, young people and adults have the human right to benefit from an education that meets their basic learning needs in the best and fullest sense of the term. In September, the Millennium Development Goals adopted two of the most important of the EFA goals:

- To ensure that by 2015 all children – including girls, children in difficult circumstances and those of ethnic minorities – have access to, and complete, free and compulsory education of good quality;
- To eliminate gender disparities in primary and secondary education by 2005.

Although efforts are mainly focused on the strengthening and reforming the school systems, it is now recognized that the child's quality of life in school is crucial: the capacity of the child to go to school, to stay in school and to learn while there. In poor countries, where ill health and poor nutrition are common, enabling good health is essential for children's physical and intellectual development.

The Government of Zambia has identified poor health and nutrition as major constraints on the quality of learning and educational achievement of it's children. Children with poor health and nutrition are less likely to enrol in school, to learn whilst in school and to complete their schooling. The education system can play an important role in ensuring that children have the health and nutrition they need in order to participate in and complete basic education.

It is recognized that some health problems, with important impacts on children's ability to learn and to stay in school, can cost- effectively be dealt with by schools themselves. School health and nutrition programs provide a cheap and effective way of reaching the poorest schoolchildren to combat nutritional deficiencies, parasitic infection and poor sanitation and to provide health education and health-promoting school policies. Such programs help remove obstacles to educational achievement and the healthy school environment they create encourages greater participation in education. This is why UNESCO identifies school health and nutrition programmes as a means to progress towards the global targets of Education for All.

The Ministry of Education's CHANGES Programme has been established to address these issues in Zambia. The programme is supported by USAID/Zambia through the Basic Education and Policy Support (BEPS) Activity, a technical assistance and support mechanism funded through the USAID Global Human Capacity Development (G/HCD) Bureau. Creative Associates International were contracted to assist the MoE in the management of this project, with technical assistance being provided by the Partnership for Child Development (PCD).

As the design of a school health programme should be tailored to the specific national context, so that the interventions are appropriate and effective, it was decided to undertake a three year 'monitoring and evaluation' assessment to evaluate the impact of the interventions provided to schoolchildren through the CHANGES programme. As part of this assessment, a baseline survey was conducted of children's health and nutrition in Eastern Province. This paper describes the findings of the baseline survey.

Methods

Schools in Chipata and Chadiza districts in Eastern Province were recruited to be part of the three-year 'monitoring and evaluation' assessment of school health and nutrition interventions. The selection of schools for the study was based on the following criteria:

- Schools were accessible throughout the rainy season
- Schools were not more than 3 hours drive from the District Centre
- Grades 3-7 were taught
- There were at least 19 children in each grade
- The school was not catering to special needs children (i.e blind, deaf etc.)

From the schools that met the criteria 80 were randomly selected to be part of the study, which was designed as follows:

Year 1: 20 schools were randomly selected as intervention schools and 20 as control schools.
Year 2: Year 1 control schools become the intervention schools for year 2. Another 20 schools will be recruited to form the year 2 control schools.
Year 3: Year 2 control schools become the intervention schools for year 3. Another 20 schools will be recruited to form the year 3 control schools.

In year 1(October 2001) anthropometric data was collected from seventy children (ten children per grade 1-7) in all 40 schools. More detailed health and nutrition information was collected for children in the intervention schools.

A basic 'health education and life skills development' package was implemented in all control and intervention schools (November 2001). Children in the intervention schools also received a package of drug interventions, involving praziquantel, albendazole, vitamin A and ferrous sulphate, that was given after the base-line data had been collected. For further information about the sampling methodology and the interventions given refer to PCD Report 2000.

The present report presents the results from the baseline survey of intervention schools for anthropometry, vitamin A deficicency, anaemia and helminth infections. The results will also be given for the validation of the questionnaire for identifying schools that require mass treatment for urinary schistosomiasis (bilharzia).

The distribution of age and sex in the intervention and control schools was examined because many indicators of health are sensitive to age and sex. No difference was found between the schools. The distributions by age and sex of children in the intervention schools are given in Figure 1. A similar profile was found for the control school group. The number of children included in the intervention school group was 1392; with 50.1% boys and 49.9% girls. The mean age was found to be 12.3 years.

Table 1 presents a summary of type of information collected, the indicators used and how they are defined and collected.

Figure 1 The percentage of children by age and sex in the intervention schools

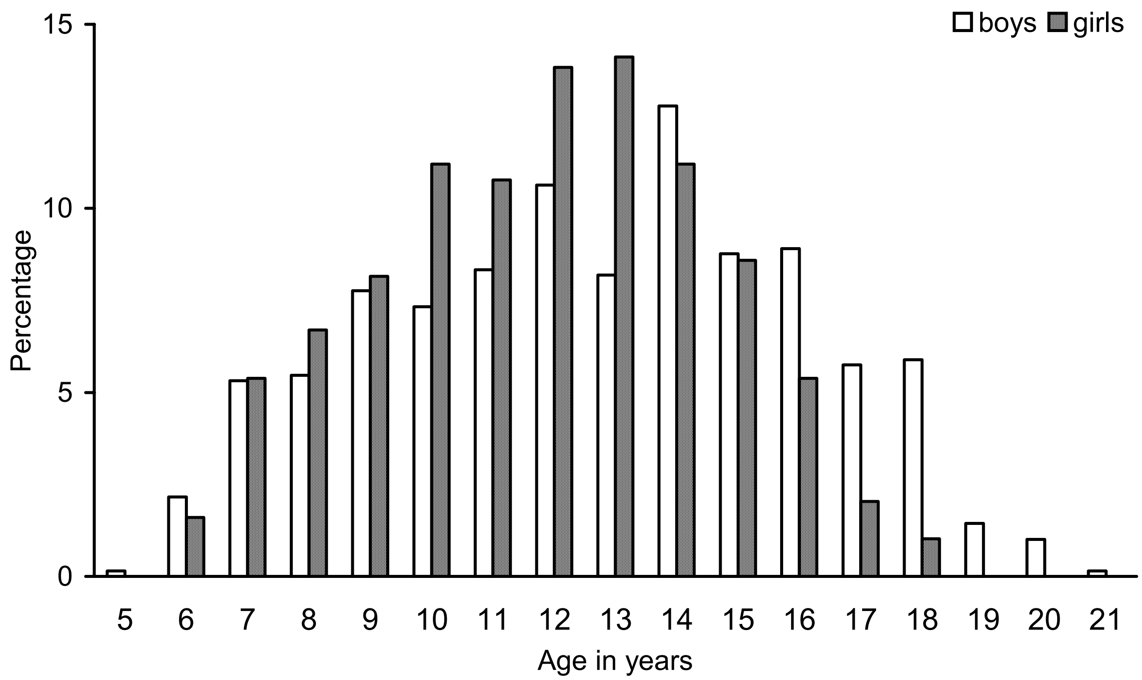


Table 1 A summary of the indicators used in the survey

Type of information	Significance for schoolchildren	Indicator(s) used in this survey	How was the data collected?	Definition of indicator(s)	Are there any major limitations?
Growth	Growth or 'anthropometric status' can be used as an indicator of malnutrition, which affects both children's access to education and their ability to learn whilst attending school. See Box 1.	Height-for-age	A child's height or weight taken and then compared with the NCHS growth reference using Anthro software. The difference is expressed as standard deviation units known as 'z-scores'.	Z-score <-2SD defines 'stunting': chronic malnutrition[1]	
		Weight-for-age		Z-score <-2SD defines 'underweight': both chronic and acute malnutrition[1]	
		Body Mass Index	A child's height (cm) is divided by its weight^2(kg) to provide a BMI score	BMI <15 is used in this study to signify 'thinness'	BMI is that it is affected by age: being 'thin' at one age may mean a different degree of malnutrition that being 'thin' at another age
Vitamin A deficiency	Deficiency can lead to visual impairment and blindness and can increase the risk of illnesses (e.g. diarrhea and measles) and death by preventing normal immune function.	Serum retinol	Blood samples are taken from children in the field and sent to a laboratory for analysis.	<20mg/dl is used to define deficiency	
Anaemia	Anaemia affects the cognitive function and educational achievement of school children. The cause of anaemia can be ron deficiency or inflammation due to disease (e.g. malaria). See Box 2.	Haemoglobin (Hb)	Blood samples are taken from children in the field and sent to a laboratory for analysis.	Hb<120g/L is used to define anaemia	It is not possible to separate anaemia due to inflammation and anaemia due to iron deficiency
		Ratio of soluble transferrin receptor to serum ferritin: this separates 'iron deficiency anaemia' from 'anaemia of inflammation'		>=2.55 is used to define 'iron deficiency anaemia'	It is a new approach and is still being explored

[1] Gibson RS (1990) Principles of Nutritional Assessment. Oxford University Press, New York.

Type of information needed	Why is it important to collect this type of information?	Indicator(s) used in this survey	How was the data collected?	Definition of indicator(s)	Are there any major limitations?
Intestinal nematode infections	Intestinal nematode infections affects children's nutritional status (e.g. anaemia) causing growth retardation and reduced learning ability.	*Ascaris lumbricoides*	Stool samples are collected in the field and sent to a laboratory for assessment	<5000egp: light 5000-50000egp: mod >50,00 egp: heavy[2]	
		Trichuris trichiura		<1000egp: light 1000-10000egp: mod >10000egp: heavy[2]	
		Hookworm		<2000egp: light 2000–4000egp: mod >4000: heavy[2]	
		Schistosoma mansoni		1-99egp: light 100-400egp: mod >400egp: heavy[2]	
		*Schistosoma haematobium (*bilharzia*)*	Urine samples are collected in the field and sent to a laboratory for assessment	<50eggs/10ml:light >=50eggs/10ml: heavy[2]	
			Self-diagnosis through questionnaire in schools can provide an estimate of the prevalence of bilharzia in a school.	If the prevalence is above a certain cut-off, mass treatment is given at the school. See 'development of schistosomiasis questionnaire' p 17	

[2] WHO "Guidelines for the evaluation of the soil-transmitted helminthiasis and schistosomiasis at community level" World Health Organisation WHO/CTD/SIP/98/1

Results

Table 2 present the findings of the baseline survey of intervention schools for indicators of nutrition and health. The table shows the percentage children who are stunted, underweight, vitamin A deficient, anaemic and have hookworm or schistosomiasis, by school and overall. An explanation of the indicators used – how the data was collected and what the indicators signify – is summarized in Table 1.

Growth

Height-for-age indicates whether a child has experienced chronic (long term) malnutrition and is stunted. The prevalence of stunting was **33%** overall. Figure 2 presents the age and sex distribution of stunting and shows that, in common with other African school children (PCD 1998), the prevalence of stunting increases with age, and that boys were more stunted than girls, particularly when older.

Weight-for-age indicates whether a child has experienced both chronic and acute malnutrition and is underweight. The prevalence of underweight was **21%** overall. Figure 3 presents the age and sex distribution and shows that, like the percentage of children stunted, the percentage underweight increased with age and affected boys more than girls.

Body mass index (BMI) is a measure of 'thinness' and acute malnutrition, and children with a BMI<15 are classified as thin. The prevalence of thinness was **21%** overall. It is not possible, at present, to interpret these results in terms of age.

Box 1: What is undernutrition and how does it affect education?

Stunting (height-for-age z-scores <-2) is a physical indicator of chronic or long-term malnutrition and is often linked to poor mental development. Stunting is a cumulative process of poor growth that primarily occurs before the age of 3 years and is not easily reversed. Underweight (weight-for-age z-scores <-2) is an indicator of both chronic and acute undernutrition.

Undernutrition affects both children's access to education and their ability to learn whilst attending school. Children's enrolment in school is more likely to be delayed if they are poorly nourished (Glewwe & Jacoby, 1995; Partnership for Child Development, 1999) because they are perceived as being too small in stature to attend school and also because parents are more willing to invest in healthy children. The impact of poor nutrition on school enrolment is greater for girls than boys (Alderman, Behrman, Lavy, & Menon, 2001). Undernourished children also perform poorly at school (Hutchinson, Powell, Walker, Chang, & Grantham McGregor, 1997; Partnership for Child Development, 2000) because they have impaired cognitive function and have reduced attention in the classroom (Sigman, Neumann, Jansen, & Bwibo, 1989; Wachs, Bishry, Moussa, et al., 1995).

Table 2: Indicators of growth, anaemia, vitamin A status and infection with intestinal helminths for all children and by school

		Growth		'Anaemia'		VAD	Intestinal nematode infections	
		Stunting: haz<-2 (%)	Underwt: waz <-2 (%)	Log TfR/sF >=2.55 (%)	Hb<120g/L (%)	Vitamin A <20 mg/l(%)	Schist. (%)	Hook (%)
Overall		33	21	17	33	36	48	55
By school	Chamanda	39	29	32	39	35	57	56
	Chikoka	42	20	30	54	39	15	63
	Chipangali	27	13	22	23	26	64	52
	Dzoole	39	31	19	44	46	66	74
	Cronje	29	21	35	21	31	69	31
	Kanzutu	40	30	10	47	52	62	59
	Kapatamoyo	37	30	10	30	31	35	44
	Katawa	33	20	12	40	50	47	48
	Kawambe	24	7	19	43	40	35	29
	Langa	36	20	16	33	42	39	54
	Lukhalo	33	26	23	37	26	56	59
	Maguya	26	14	14	33	23	29	51
	Makwe	33	20	13	26	36	39	59
	Mnukwa	33	12	25	28	36	29	49
	Nkhoto	31	16	15	29	44	44	69
	Njaviombo	34	22	11	26	30	64	63
	Nza dzu	36	24	6	34	21	53	55
	Tamanda	32	22	6	19	25	21	68
	Vizenge	26	14	15	36	41	62	57
	Vubwi	31	24	16	26	51	61	62
	min	24	7	6	19	21	15	29
	max	42	31	35	54	52	69	74

Figure 2 The percentage of stunted boys and girls by age

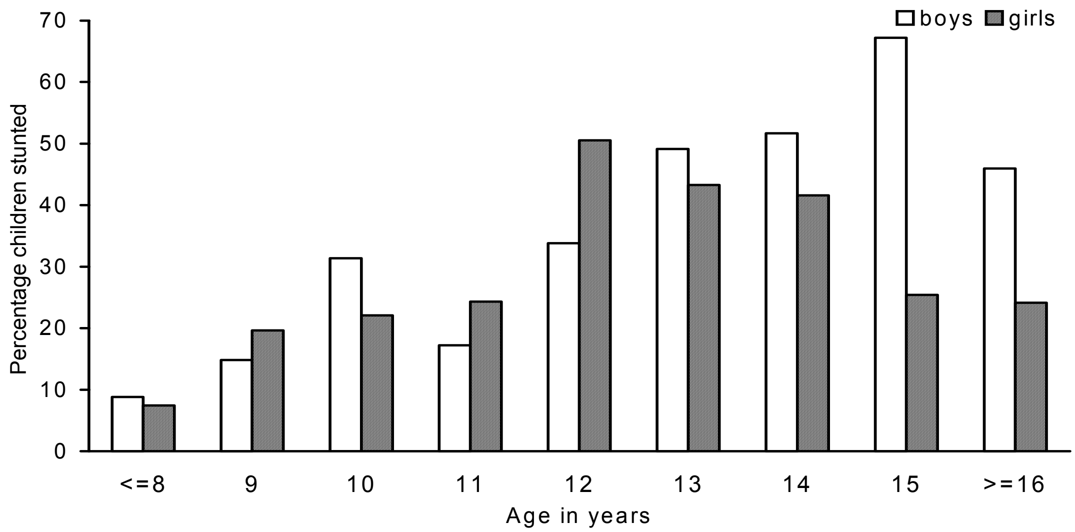
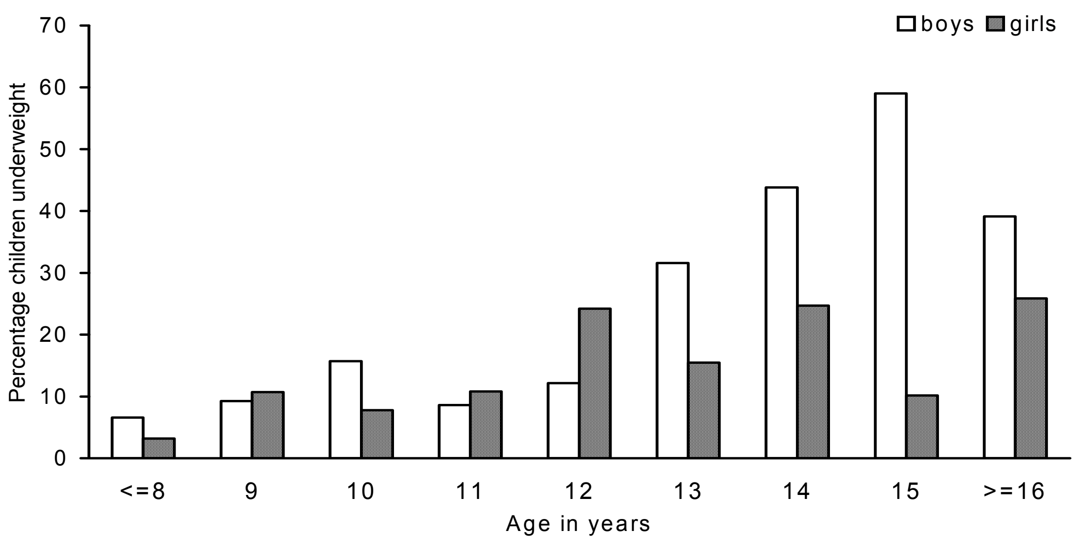


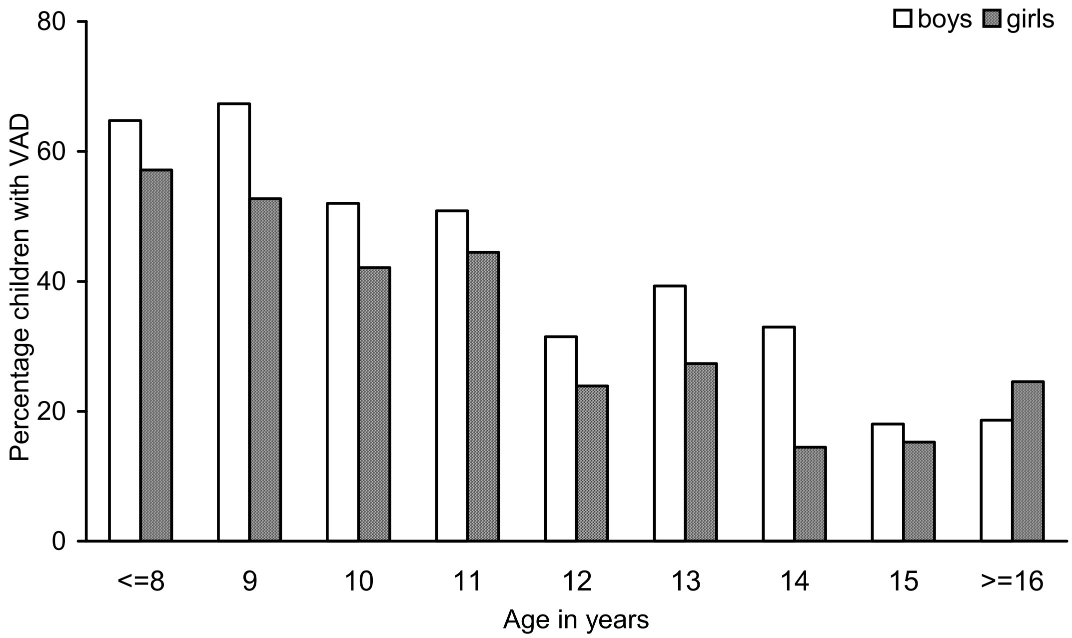
Figure 3 The percentage of underweight boys and girls by age



Vitamin A deficiency (VAD)

Vitamin A deficiency can lead to visual impairment and blindness and can increase the risk of illnesses (e.g. diarrhea and measles) and death by preventing normal immune function. The prevalence of VAD was **36%** overall. Vitamin A status was most common among younger children. This is shown in Figure 4. Further analysis revealed that vitamin A deficiency was associated with anaemia (as defined by low haemoglobin) and the odds of being anaemic was 2.5 times higher if the child was vitamin A deficient.

Figure 4 The prevalence of vitamin A deficiency (VAD) among boys and girls by age



Anaemia

The measurement and meaning of anaemia is summarized in Box 2. The prevalence of anaemia was **33%** (Hb< 120g/L) overall with 0.5% being found to be severely anaemic (Hb< 85g/L). Figure 5 shows that older children tended to have higher Hb concentrations than younger children, and so anaemia was more common among younger children. Boys tended to be more anaemic than girls (36% vs 30%) but among children older than 15 years girls were more anaemic than boys. Table 3 shows how the findings compare with studies of other schoolchildren in Africa.

The prevalence of iron deficiency anaemia (log TsR/sF>=2.55) was 17%. Figure 6 shows that there was little difference between boys and girls (19% *vs* 16%) and varied less by age than the prevalence of anaemia based on haemoglobin concentrations (Figure 7).

The two indicators of anaemia are poorly associated with each other at baseline. This may have been caused by a variety of factors such as infection with malaria. Further analysis with data from the resurvey will allow us to explore further the nature of anaemia in Eastern Province.

Box 2: Anaemia

What is anaemia?
Haemoglobin is an iron-containing protein in red blood cells that carried oxygen from the lungs to cells throughout the body. Without sufficient oxygen the physical capacity of individuals is reduced. Anaemia is defined as a haemoglobin concentration below which the body's function becomes impaired. In this study the cut off used was 120g/L.
How does it affect schoolchildren?
Many studies have explored the impact of nutrition on children's enrolment and achievement in school (Alderman *et al,* 2001; Glwwe and Jacoby, 1995; Hutchinson *et al,*1997; PCD, 1999; PCD, 2000; Sigman M

et al 1989; Wachs *et al*, 1995). There is good evidence that anaemia affects the cognitive function and educational achievement of school children (Grantham-McGregor and Ani, 2001). Anaemic children perform poorly in educational tests (Pollitt *et al* 1989) but iron supplementation can improve concentration and school exam scores (Soemantri *et al* ,1985)

Iron deficiency and iron deficiency anaemia
The size of the body's iron reserve (mostly in the liver) is taken as an index of iron nutritional status. Iron deficiency occurs in three stages:

1. **Depleted iron stores**: This occurs when the body no longer has any stored iron but the haemoglobin concentration remains above the established cutoff. A depleted iron store is defined by a low serum ferritin concentration (<12mg/L). It is important to note that because ferritin is an acute-phase reactant, its concentration in the blood increases in the presence of infectious or inflammatory diseases; thus, it cannot be used to accurately access depleted iron stores in settings such as Eastern Zambia where poor health is common.
2. **Iron deficient erythopoiesis**: Red blood cells that are developing have the greatest need for iron. The reduced transport of iron is associated with iron-deficient erythropoiesis. However, haemoglobin concentrations remains above the established cut off levels. This condition is characterized by an increase in the transferrin receptor concentration and increased free protoporphysin in red blood cells.
3. **Iron deficiency anaemia** (IDA): IDA developed when the iron supply is inadequate for haemoglobin synthesis, resulting in haemoglobin concentrations below the established cutoff levels. To diagnose IDA, measurements of iron deficiency as well as haemoglobin concentrations are needed.

For practical purposes, the first and second stages are often referred to collectively as iron deficiency

Other causes of anaemia
Other nutrient deficiencies have been associated with anaemia. These include deficiencies of vitamin A, B6 and B12, riboflavin and folic acid, although not all the causal pathways have been clearly established.

Besides specific nutrient deficiencies, general infections and chronic diseases including HIV/AIDS, as well as blood loss, can cause anaemia. For example, the risk of anaemia increases when individuals are exposed to malaria and helminth infections.
Malaria, especially from protozoan *Plasmodium falciparum* causes anaemia by rupturing the red blood cells and by suppressing the production of new red blood cells. Malaria does not, however, cause iron deficiency, because much of the iron in haemoglobin released from the ruptured cells stays in the body.
Helminths such as hookworms and flukes such as schistosomes can cause blood loss and therefore iron loss. Adult hookworms attach themselves to the gut wall, where they mature larvae and adult worms ingest both the gut wall and blood. Hookworms change feeding sites every 4-6 hours and during feeding secrete anticoagulant, resulting in secondary blood loss from the damaged gut wall after the worms have stopped feeding. The number of adult hookworms and the faecal egg count, which is an indirect estimate of the number of worms, are strongly correlated with the amount of blood lost. If too much blood is lost, this can result in iron deficiency anaemia.

The nematode *Trichuris trichiura* can cause anaemia when the worm burden is heavy. Heavy infections also cause inflammations and dysentery, which in turn can cause further blood loss.

Severe infections with the trematode *Schistosoma haematobium* (bilharzia) can cause significant urinary blood loss. The effect of this blood loss can be significant even in moderate infections if the person is young and already iron deficient. The eggs are wedged into capillaries by female worms when they are laid, and the mechanical movements of the body push them into the bladder wall The emerging eggs rupture the bladder wall, causing blood to leak into the bladder. With *Schistosoma mansoni* emerging eggs rupture the intestinal lining, resulting in the leakage of blood and other fluids and nutrients into the lumen.

Why is it important to know the underlying cause of anaemia?
Anaemia can be caused by iron deficiency or by other nutritional and health factors. The distinction between causes is important for two reasons:

1. Haemoglobin measurements are important in diagnosing anaemia, but they are neither sensitive to nor specific to iron deficiency.
2. The success of any intervention to correct and control anaemia depends on whether the intervention deals with the underlying causes. In many developing countries, it is unlikely that all anaemia results from a diet lacking in iron, because other nutritional deficiencies as well as malaria, heavy loads of helminths and other inflammatory/infectious diseases also cause anaemia.

Knowing the underlying causes of anaemia will enable programme managers to identify which interventions need to be implemented to reduce the high prevalence of anaemia in many countries. Where most of the anaemia is not the result of iron deficiency, iron supplementation or the fortification of food with iron will be inadequate by themselves to prevent and control anaemia.

The ratio of serum transferrin receptor and serum ferritin to diagnose iron status
Many laboratory measurements used to estimate iron status (such as serum iron, ferritin, transferrin saturation, mean cell volume and free erythrocyte protoporphyrin) cannot clearly distinguish iron deficiency anaemia from anaemia due to other reasons, such as disease. A new approach is currently being explored that can: the ratio of serum transferrin receptor (TfR) and serum ferritin (sR). This is a combination of measurements of iron stores and of functional tissue iron.

A recent study of preschool children in South Africa found that subjects with iron deficiency had a Log TfR/sR ratio > 2.55, whereas in all subjects classified as anaemic due to inflammation had values <2.55. The method was not able to exclude IDA in the presence of inflammation. In children with anaemic due to both iron deficiency and disease the ratio was <2.55 but increased to >2.55 after resolution of the inflammation.

This novel method of calculating the Log TsR/sF ratio may provide a more precise classification of the iron status of children. It is strongly felt that the extra investment in this new technique of measuring iron status, along side the measurement of haemoglobin, will provide valuable information for the evaluation of the impact of the intervention strategies. Furthermore, the employment of the techniques in the survey has allowed an excellent opportunity for building capacity at the Tropical Disease Research Centre.

Figure 5 The percentage of boys and girls with anaemia (haemoglobin<120g/L)

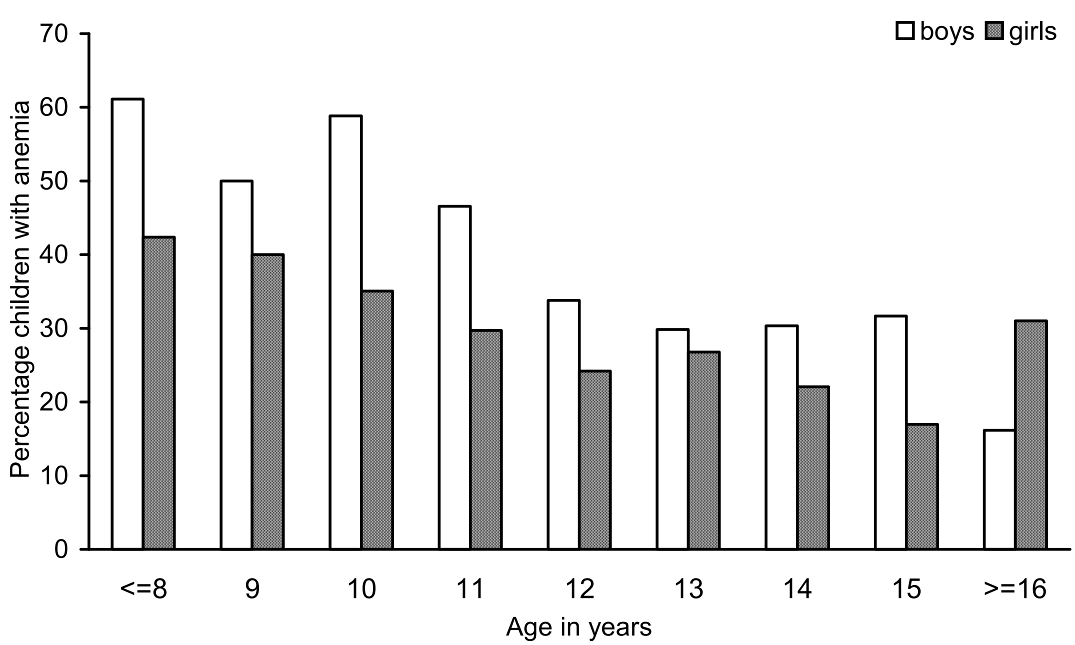


Figure 6 The percentage of children with iron deficiency anaemia (log TsR/sF >=2.55)

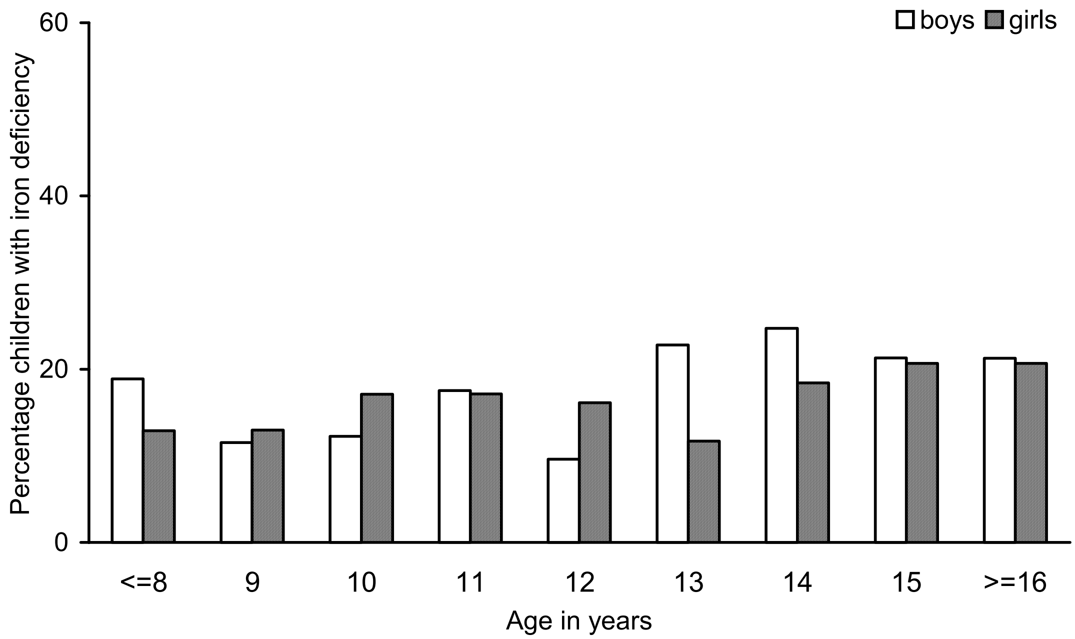


Table 3 The percentage children anaemic (haemoglobin <110g/L), stunted and underweight in Eastern Province, Zambia, compared with other African school children.

Country	Percentage children			Source
	Hb<110	Stunted	Underweight	
Zambia (E. Province)	13.0	32.7	20.6	Present report
Chad	25.1	18.7	16.5	Beasley *et al*. (2002)
Ghana	11.0	56.2	46.2	PCD (1998)
Tanzania (coast)	49.8	82.6	67.7	PCD (1998)
Tanzania (Lake Victoria)	31.2	42.5	43.0	Lwambo *et al*. (2000)

Infection with Intestinal Nematodes

Hookworm

The prevalence of hookworm was **55%**. More boys were infected than girls (69% vs. 49%). The prevalence of infection did not vary greatly with age (Figure 7). All hookworm infections were 'light' (<2000 egp).

Trichuris and *Ascaris*

The prevalence of *Ascaris* (roundworm) and *Trichuris* (whipworm) was found to be less than 2%. This suggests that these infections are not a significant health problem in Eastern Province.

Schistosoma Infections (Bilharzia)

The prevalence of bilharzia infection was **48%**; 27% were lightly infected and 21% were heavily infected. There was little difference between boys and girls (49% vs 46%). Other studies have shown that infections with schistosomes are most common at around 15 years of age, and this was also found in Eastern Province (Figure 8). The prevalence of S*chistosoma. mansoni* was only 5% and does not appear to be a significant health problem in Eastern Province.

Multiple infections

More than a quarter of children were both infected with schistosomiasis and hookworm (28%). There is particular concern for children with heavy schistosomiasis infections as well as hookworm infections (13%), which tended to be more common among boys than girls (16% vs.10%). Infections with intestinal nematodes are common among school children in many African countries. Table 4 presents the results from the baseline survey in Eastern Province compared with other studies of schoolchildren in Africa.

Figure 7 The percentage of children with hookworm infections.

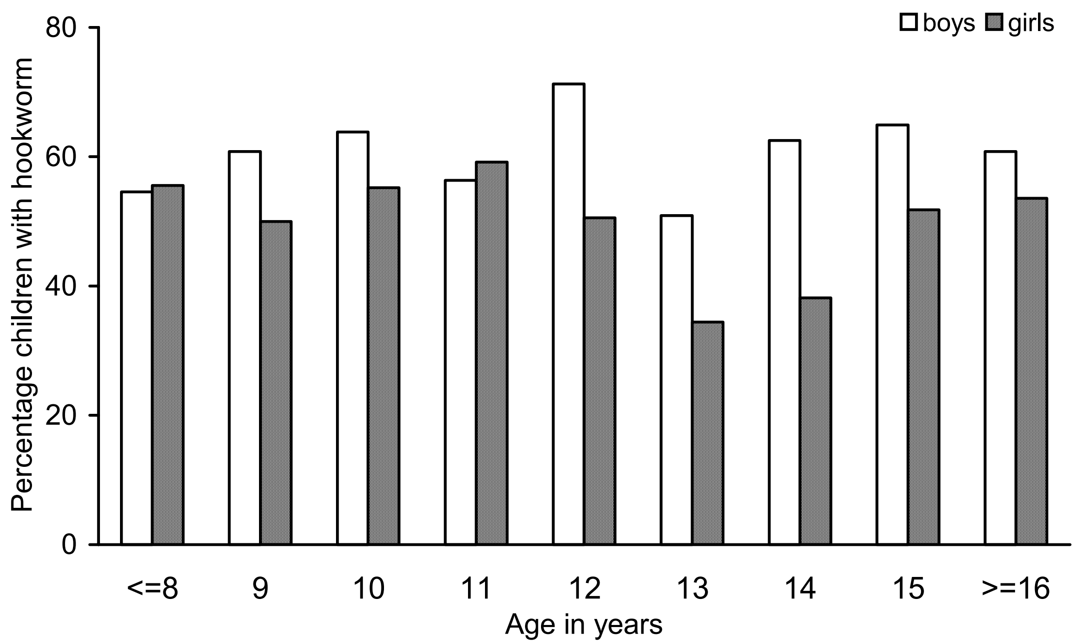


Figure 8 The average intensity of schistosomiasis infections (eggs/10ml) by age, with standard error bars.

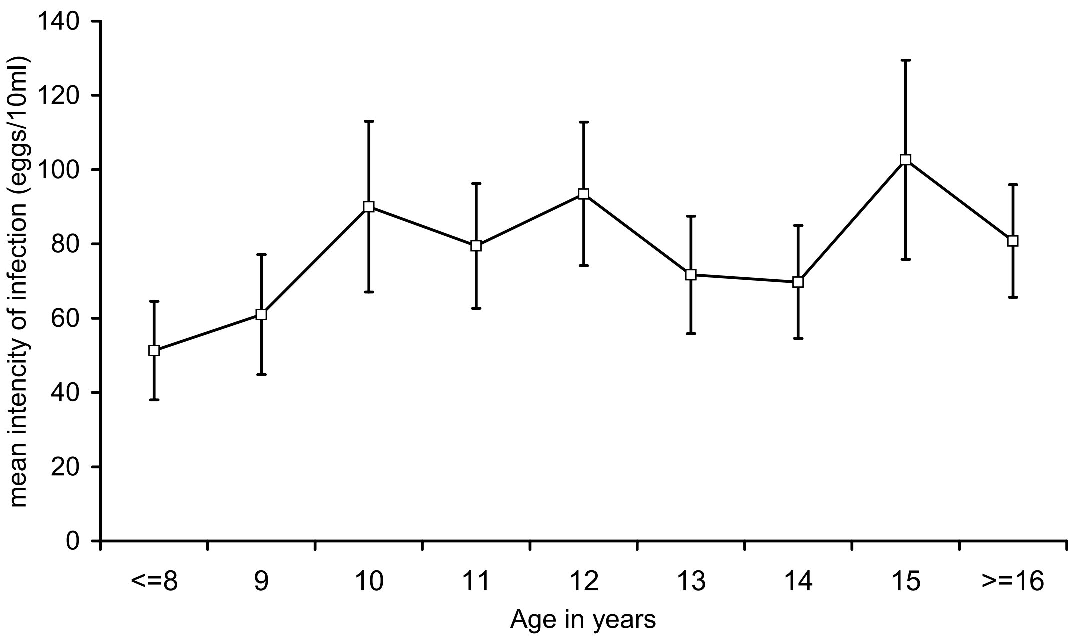


Table 4 The percentage children infected with Ascaris, Trichuris and hookworm in Eastern Province, Zambia, compared with other African school children.

Country	Percentage infected children			Source
	Ascaris	Trichuris.	Hookworm	
Zambia (E. Province)	1.8	0.9	54.9	Present report
Cameroon	40.2	52.1	18.0	Ratard *et al*. (1991, 1992)
Chad	0.0	0.0	32.7	Beasley *et al*. (2002)
Ethiopia	51.6	48.7	25.1	McConnell & Armstrong (1976)
Ghana	9.0	0.6	49.0	PCD (1998).
Kenya	41.9	55.2	77.5	Brooker *et al*. (2001)
Tanzania	20.0	11.0	63.0	PCD (1998)
Uganda	17.5	7.3	44.5	Kabatereine *et al*. (2001)

Variation between schools

Table 2 shows that there exists a large variation between schools in the prevalence of iron deficiency (from 6% to 35%), anaemia (from 19% to 54%), infections with hookworm (from 29% to 74%), schistosomiasis (from 15% to 69%), stunting (from 24% to 42%) and underweight (from 7% to 31%).

Regression analysis showed that ‘school’ was a highly significant determinant of all health and nutrition indicators. The findings suggest that geographical variations in factors that were not included in the study - such as environmental conditions and the epidemiology of diseases - can help explain variations in the prevalence of schistosomiasis and vitamin A deficiency, which in turn affect children’s iron status.

Children in some schools seemed to be more affected by poor health and nutrition than in other schools. Dzoole school, for example, had one of the highest percentages of stunted and underweight children, anaemia, vitamin A deficiency and infections with both schistosomiasis and hookworm. Chamanda, Chikola, and Kanzutu schools also a high percentage of children with poor nutrition and health. Children in Chipangali and Maguya schools were, on the other hand, much better off.

6 month microsurvey of reinfection

Six months after the children in the intervention schools were given treatment a resurvey took place in a sub-sample of children. The number of children surveyed was 141 divided between 4 schools (Lukhalo, Mnukwa, Cronje and Kapatamoyo).

The survey showed that the anthelminthic treatments given November 2001 had been highly effective. The prevalence of hookworm had fallen from 55% to 8%. The mean intensity of infection had fallen by 98%, from 247 eggs per gram of faeces at baseline to 6 eggs per gram. The prevalence of bilharzia had fallen from 48% to 24%. The mean intensity of infection had fallen by 73% from 77 eggs/10ml urine at baseline to 21 eggs/10 ml urine at follow up. Most infections observed at this time point were very light, again indicating that morbidity (illness) has been significantly reduced

Eastern Province has experienced severe famine since the baseline data was collected, which is thought to explain why anaemia had become a serious problem. he overall prevalence of anaemia (haemoglobin<120g/L) had increased from 33% to 75%. The prevalence of severe anaemia (haemoglobin < 85g/l) had increased from 0.5% to 5%. (All children found to be severely anaemic at the resurvey were referred to their nearest health centre).

Development of the Schistosomiasis Questionnaire

A questionnaire, designed by teachers and health workers from Eastern Province, to allow schoolchildren to self-diagnose schistosomiasis, was validated (Hall *et al* 1999). The questionnaire included the following two questions asked by teachers to children in the local language, Nyanja (see Appendix for a copy of the questionnaire):

1. Have you had schistosomiasis (bilharzia) during the last two weeks?
2. Have you experienced blood in your urine during the last two weeks?

These questions were masked by other questions about the general health of the child in order to avoid biased responses.

The response to these two questions was highly similar, with **36%** of children responding positively to question 1 and **33%** to question 2.

Analysis of the sensitivity (% true positives detected) and specificity (% positive responses that are true positives) to the first question indicated encouraging levels of both sensitivity (54%) and specificity (71%). This suggests that the self reporting questionnaire is an effective diagnostic tool for use in Eastern Province.

Questionnaire techniques usually underestimate the prevalence of infection with *S. haematobium* by around 20%. In this case, both questions underestimated *S. haematobium* infection in Eastern Province by around **15%**, as illustrated in Figure 9 and 10. This suggests that the questionnaire developed at the August 2001 workshop is working extremely well.

WHO guidelines specify that a prevalence of 50% infection warrants mass treatment; since both questions underestimated *S. haematobium* infection in Eastern Province by around 15%, this would suggest that a positive response to the questionnaire of greater than 35% indicates the need for mass treatment with praziquantel.

Figure 9 The percentage children with schistosomiasis eggs in their urine compared with the percentage children that reported to have had schistosomiasis in the last two weeks, b**y school. An exponential regression regression line is added.**

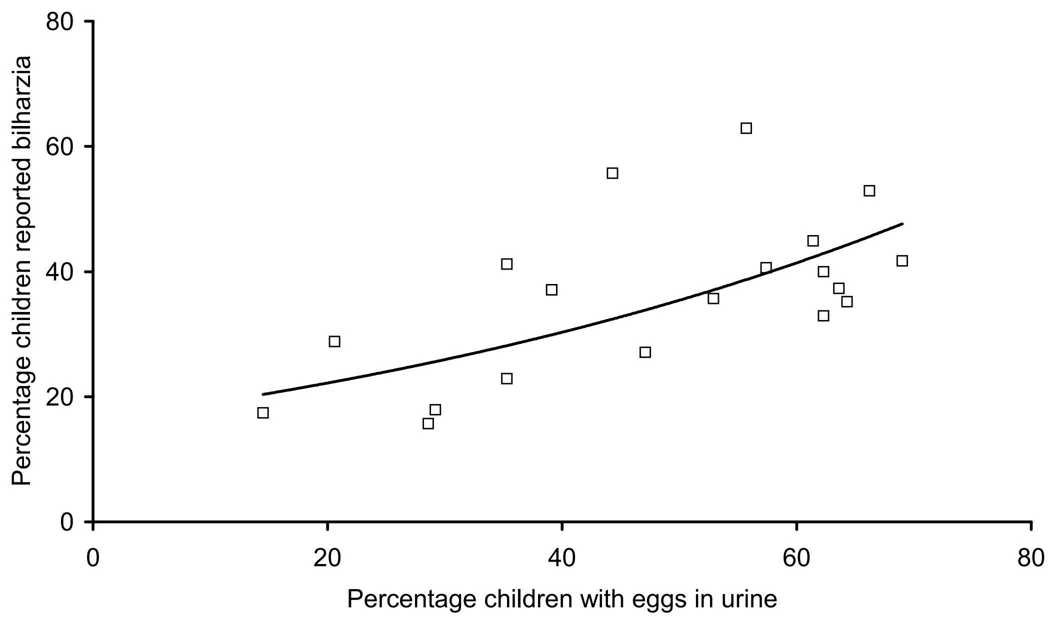
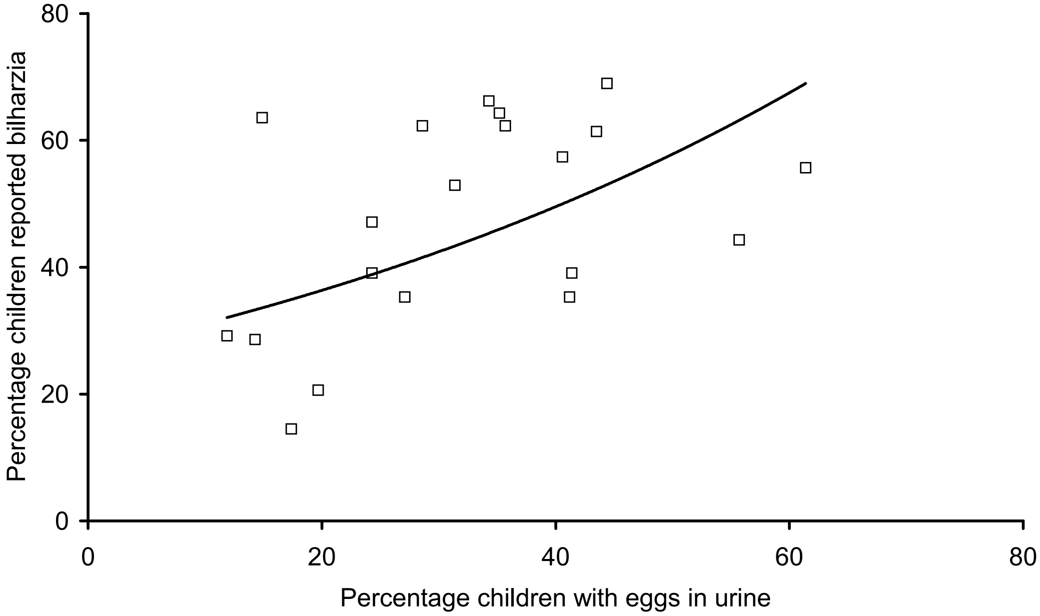


Figure 10 The percentage children with schistosomiasis eggs in their urine compared with the percentage children that reported to have blood in their urine in the last two weeks, by school. An exponential regression regression line is added.



Validation of a Zambian Height Pole

This validation was completed prior to the baseline survey, but for completeness is added to this report.

The heights and weights of 765 children in grades 1 to 7 attending six schools in Chongwe District were measured. The height and weight of each child was measured to the nearest 0.1 cm and 0.1 kg respectively using a stadiometer (‘Leicester’ Model, Child Growth Foundation, UK) and electronic scales (Soehnle, CMS Weighing Equipment, UK).

The ‘height pole’ was developed targeting a dose of 50 mg/kg, in order to avoid under dosage and was designed to identify 5 height intervals corresponding to 1½, 2, 2 ½, 3 and 4 tablets of praziquantel.

The ‘height pole’ was developed using the method described by Hall *et al*. (1999) from data collected during the school survey. For the data, the following parameters were calculated: (I) the number of individuals of which the height was within the interval identified by the pole (110-178 cm); (II) the percentage of individuals that would have received appropriate dosages of 30-40 mg/kg, and 40-60 mg/kg, respectively; (III) the percentage that would have received a dosage of less than 30 mg/kg, considered to be sub-curative and therefore of concern in view of the possible development of drug resistance; (IV) the percentage of individuals that would have received a dosage of more than 60 mg/kg, considered to be of concern because of the possible occurrence of side effects; (V) the minimum and maximum dose that would have been administered.

Figure 11 shows the relationship between bodyweight and height for 765 Zambian schoolchildren. The best-fit function was determined by maximizing r^2 and was used to predict the bodyweight of each child from height and used to develop a ‘height pole’ (Figure 12).

Figure 11 The relationship between bodyweight of 765 Zambian schoolchildren and height. The equation for the lines of best fits are shown and r, the correlation coefficient

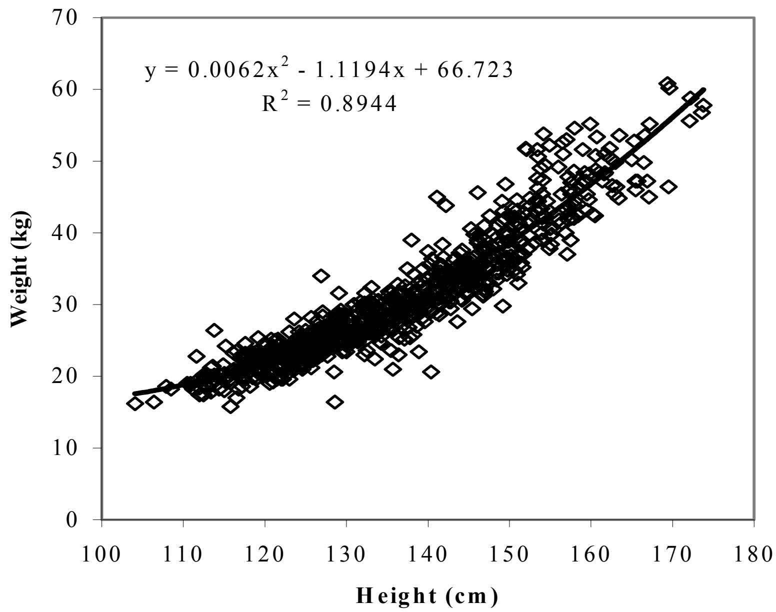
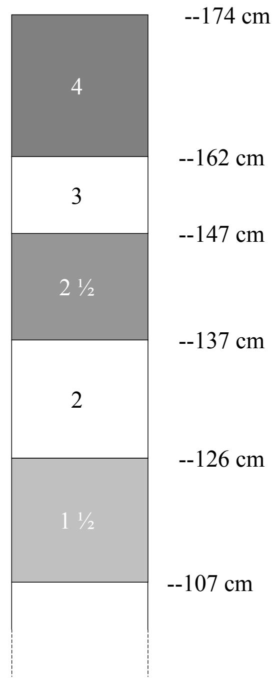


Figure 12 The 'height pole' consisting of five height intervals and the praziquantel dosage(in tablets) assigned to each interval.



If the developed height pole was used to determine the dose of praziquantel, more than 94.2% of children would have received a dose ranging between 40 and 60mg/kg. 99.2% of children would have received a dose ranging between 30 and 60 mg/kg. No child would have received less than 20 mg/kg and 6 children (0.8%) would have received more than 60 mg/kg. The minimum dose was 23mg/kg and the maximum dose was 61 mg/kg.

Summary

Chronic malnutrition is a problem in Eastern Province and a third of children were stunted. In common with other populations of African school children, the prevalence of stunting and underweight increases with age and affects more boys than girls.

Vitamin A deficiency was most common among young children. More than half of children under 10 years old were vitamin A deficient. Analysis revealed that deficiency was associated with low haemoglobin concentrations.

Anaemia, as measured by low haemoglobin, affected a third of all children and especially the young. The prevalence of iron deficiency anaemia was lower, as indicated by log TsR/sF>=2.55. This indicator appeared to vary less by age and sex than haemoglobin, and the two indicators were poorly associated. It is hoped that further analysis with data from the coming resurvey will allow us to explore the causes of anaemia in the Eastern Province more closely.

More than half of children were infected with hookworm, but all infections were classified as light. Almost half were infected with urinary schistosomiasis (bilharzia), and almost a quarter were heavily infected. The prevalence of *Ascaris* (roundworm), *Trichuris* (whipworm) and *schistosoma mansoni* was very low.

There was a large variation between schools in the prevalence of iron deficiency (from 6% to 35%), anaemia (from 19% to 54%), infections with hookworm (from 29% to 74%), schistosomiasis (from 15% to 69%), stunting (from 24% to 42%) and underweight (from 7% to 31%). The findings suggest that geographical variations in factors excluded in this analysis, such as environmental conditions and disease, can help explain the variations in the indicators.

The resurvey in a sub-sample of schools after six months showed that the anthelminthic treatments given November 2001 had been highly effective: the prevalence of hookworm had reduced from 55% to 8% and schistosomiasis from 48% to 24%. However, anaemia had increased from 33% to 75% and severe anaemia had increased from 0.5% to 5%. This was probably due to the recent severe famine in the area.

The questionnaire designed to allow schoolchildren to self-diagnose schistosomiasis was validated. The findings showed that the questionnaire technique was successful and allowed the identification of schools that needed mass treatment.

Recommendations

- The follow up survey has shown that reinfection with both hookworm and bilharizia has been slight. The results suggest that in Eastern Province, mass treatment for bilharzia and hookworm needs to occur only annually. There is no need to re-treat children every six months.

- The enormous increase in both anaemia and severe anaemia is clearly a matter of enormous concern. These data should be shared with the public health authorities in Zambia at the earliest possible opportunity.

- The Zambian tablet pole has been validated, and so can be used on a National scale.

- The questionnaire developed for Eastern Province is an exceptionally good tool for all Nyanja speaking communities. However, if expansion is to proceed, then workshops need to be held to adapt the questionnaire to other languages.

- If the programme is to expanded to other Provinces then mini-surveys need to be conducted in order to evaluate prevalence and intensity of disease.

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Mr Richard Suswillo (Programme Manager)

Partnership for Child Development

August 2002

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Appendix

Teacher: please complete this form and return it to your Head Teacher

Name of school	
Zone/District	
Name of Teacher	
Sex of Teacher (M or F)	
School Code/EMIS number	

Date: (day/month/year)	- -
Grade	
School Status	
Total girls enrolled in class	
Total boys enrolled in class	
Total boys present today	
Total girls present today	

Please call up each child, one by one, and write the child's name, admission number, age and sex in the column below. Then ask the child: "In the last 2 weeks have you had a Headache?" Write down the answer in the same column, below, put (√) for "Yes", (O) for "No" and (?) for "Don't know". Continue with the next problem and record the answers below.

Serial Number	e.g.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Name of child																					
Admission Number	1233																				
Age (years)	12																				
Sex (M or F)	F																				

Cough/*Cifuwa*	√																				
Headache/*Mutu*	**O**																				
Scabies/Ringworm/*Mphere/Cipere*	√																				
Bilharzia/*Likodzo*	√																				
Malaria/*Malungo*	√																				
Toothache/*Dzino*	?																				
Abdominal pain/*M'mimba*	**O**																				
Eye infection/*Maso*	√																				
Blood in urine/*Magazi mukodzo*	**O**																				
Ear infection/*M'matu*	√																				
Worms passed/*Njoka zamimmba*	**O**																				
Cut or wound/*Cilonda*	**O**																				
Lice/*Nsabwe*	√																				
Jiggers/*Matekenya*	**O**																				

Serial Number	e.g.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Name of child																					
Admission Number	1234																				
Age (years)	12																				
Sex (M or F)	F																				

Cough/*Cifuwa*	√																				
Headache/*Mutu*	**O**																				
Scabies/Ringworm/*Mphere/Cipere*	√																				
Bilharzia/*Likodzo*	√																				
Malaria/*Malungo*	√																				
Toothache/*Dzino*	?																				
Abdominal pain/*M'mimba*	**O**																				
Eye infection/*Maso*	√																				
Blood in urine/*Magazi mukodzo*	**O**																				
Ear infection/*M'matu*	√																				
Worms passed/*Njoka zamimmba*	**O**																				
Cut or wound/*Cilonda*	**O**																				
Lice/*Nsabwe*	√																				
Jiggers/*Matekenya*	**O**																				

Thank you teacher

Serial Number	e.g.	41	42	43	44	45	46	47	48	4	50	51	52	53	54	55	56	57	58	59	60
Name of child																					
Admission Number	1234																				
Age (years)	12																				
Sex (M or F)	F																				

Cough/*Cifuwa*	√																				
Headache/*Mutu*	**O**																				
Scabies/Ringworm/*Mphere/Cipere*	√																				
Bilharzia/*Likodzo*	√																				
Malaria/*Malungo*	√																				
Toothache/*Dzino*	?																				
Abdominal pain/*M'mimba*	**O**																				
Eye infection/*Maso*	√																				
Blood in urine/*Magazi mukodzo*	**O**																				
Ear infection/*M'matu*	√																				
Worms passed/*Njoka zamimmba*	**O**																				
Cut or wound/*Cilonda*	**O**																				
Lice/*Nsabwe*	√																				
Jiggers/*Matekenya*	**O**																				

Thank you teacher

Serial Number	e.g.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Name of child																					
Admission Number	1234																				
Age (years)	12																				
Sex (M or F)	F																				

Cough/*Cifuwa*	√																				
Headache/*Mutu*	**O**																				
Scabies/Ringworm/*Mphere/Cipere*	√																				
Bilharzia/*Likodzo*	√																				
Malaria/*Malungo*	√																				
Toothache/*Dzino*	?																				
Abdominal pain/*M'mimba*	**O**																				
Eye infection/*Maso*	√																				
Blood in urine/*Magazi mukodzo*	**O**																				
Ear infection/*M'matu*	√																				
Worms passed/*Njoka zamimmba*	**O**																				
Cut or wound/*Cilonda*	**O**																				
Lice/*Nsabwe*	√																				
Jiggers/*Matekenya*	**O**																				

Thank you teacher