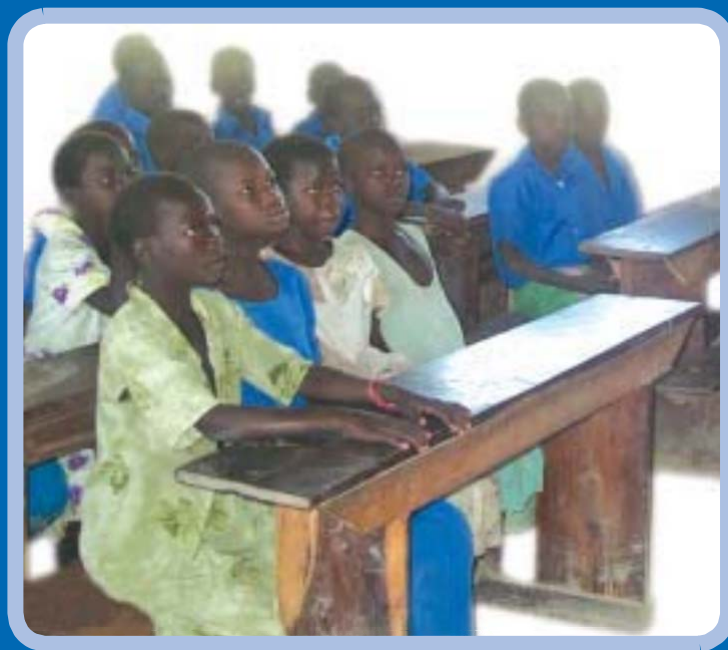




in collaboration with
Nutrition Works

School-Age Children

THEIR NUTRITION AND HEALTH



World Food Programme



Acknowledgments

This article was first published in SCN News, No. 25, December 2002 and reprinted with full permission, by the Partnership for Child Development (PCD), Department of Infectious Disease Epidemiology, Imperial College, London, UK.

SCN News is a bi-annual publication providing peer-reviewed information on issues of importance in the field of international nutrition and is issued by the United Nations System Standing Committee on Nutrition (SCN). Further information can be found at: <http://www.unsystem.org/scn>

The Partnership for Child Development gratefully acknowledges funding assistance in the printing of this pamphlet from the World Bank.

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Foreword

DON BUNDY

Lead Specialist of School Health and Nutrition, World Bank,
and Outgoing Chair of the SCN Working Group on
Nutrition of School-Age Children



The nutrition and health of school-age children is back on the global agenda. At the 27th Session of the SCN in Washington, DC (2000), an extraordinary meeting of the Working Group on Nutrition of School-Age Children resolved to promote more research and operational work on the nutrition of this age group.

In April 2000, a partnership of UN agencies, including UNESCO, WHO and UNICEF, with the World Bank and Education International used the World Education Forum in Dakar, Senegal to launch a joint effort to Focus Resources on Effective School Health, Nutrition and Hygiene (FRESH). This FRESH partnership emphasised the importance of hunger, malnutrition and ill health as constraints on both 'Education for All' and the second and third Millennium Goals of achieving universal primary education and gender equality in education access.

Since then more than 20 low-income countries have launched FRESH programmes targeting more than 45m school children. These programmes seek to ensure that all schools:

- have effective nutrition and health policies;

- offer adequate sanitation and access to water;
- deliver effective life skills messages about nutrition, health and hygiene; and
- provide access to nutrition and health services.

Similarly, the WFP, in partnership with bilaterals and civil society organisations, has sought to promote girls' access to school through a global Food for Education Programme. WFP, the World Bank and WHO are also active partners in the Partnership for Parasite Control, which seeks to ensure that children's nutrition is not compromised by worm infection. Representatives of the ministries of health and education of 21 countries have been trained in how to implement effective, school-based deworming programmes, and programmes have already begun in 19 of the 41 endemic countries in Africa.

While it is the countries themselves that have taken the lead in these operations, the Working Group secretariat has been an important catalyst. I would particularly like to acknowledge the contributions of Lesley Drake (Partnership for Child Development), Joy Del Rosso (Save the Children), Krishna Belbase (UNICEF) and Seung-hee Lee (World Bank).

The following report was developed in response to the second part of the mandate of the Working Group: to promote research and understanding of the nutrition and health of school-age children. The review confirms that much remains to be done for school-age children. And in handing over to the incoming Co-Chairs of the Working Group - Joy Del Rosso and Arlene Mitchell (WFP) - I am confident that much more will be done for them.

School-Age Children: Their Nutrition and Health

Prepared for the SCN Working Group on Nutrition of School-Age Children by:
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Introduction

The success of child survival programmes and the expansion of basic education coverage have resulted in a greater number of children reaching school-age^a with a higher proportion actually attending primary school¹. However, there is increasing evidence, with resulting international concern, that the high level of nutritional deprivation combined with the heavy burden of disease in this age group has negative consequences for a child's long term overall development. This has prompted an increased focus on the diverse needs of the school-age child.

An understanding and awareness of the heavy burden of malnutrition and disease among school-age children is growing although until recently there have been relatively few large scale surveys that document levels of morbidity in any detail. While a better picture of the health and nutrition status of this age group is being built, the true extent of the burden of ill health and malnutrition is still not fully known².

The main nutritional problems facing the school-age child include stunting, underweight, anaemia and iodine deficiency and, on the basis of information from recent surveys, vitamin A deficiency. In countries experiencing the 'nutrition transition', overweight and obesity are increasing problems in the school-age child.

The main health problems facing school-age children are malaria, helminth infections,

diarrhoeal diseases, respiratory infections and the direct and indirect effects of HIV/AIDS. Much of the disease burden derives from the poor environmental conditions in which children live including exposure to biological, chemical and physical hazards in the environment and a lack of resources essential for human health.

This paper addresses the most common nutrition and health problems in turn, assessing the extent of the problem; the impact of the condition on overall development, and what programmatic responses can be taken to remedy the problem through the school system. The paper also acknowledges that an estimated 113m children of school-age are not in school³, the majority of these children living in Sub-Saharan Africa and South-East Asia. Poor health and nutrition that differentially affects this population is also discussed.

Malnutrition

Malnutrition refers to disorders resulting from an inadequate diet or from failure to absorb or assimilate dietary elements.

Stunting (low height-for-age) 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 three years and is not easily reversed. This infers that these first years of life provide a window of opportunity for effective nutritional programming. Underweight (low weight-for-age) is an indicator of both chronic and acute undernutrition. Wasting (low weight-for-height) is an indicator of acute undernutrition.

^aChildren of school-age are defined here as 5-14 years of age. WHO defines adolescents as children aged 10-18 years of age. It is common for adolescents to be attending primary school and thus many of the studies of primary school children will also include adolescents.

Few representative data are available on the levels of malnutrition in school-age children, however, the available data on school-age children follow the regional pattern of the more extensive representative data from surveys of preschool children.

Stunting, Wasting and Underweight

PRE-SCHOOL CHILDREN: The prevalence of stunting, underweight and wasting varies by region and subregion throughout low income countries^b. The Africa region has the highest estimated prevalence of stunting (20.2-48.1%)^c and has the lowest rate of improvement. In East Africa sub-region, rates of stunting are increasing. The prevalence of stunting in Asia (32.8-43.7%)^d is also high, particularly in South Central Asia, although rates of stunting continue to improve throughout this region. In Latin America and the Caribbean, the prevalence of stunting is significantly lower (9.3- 24%)^e than the other two regions and is improving, except in the Central America sub-region.

For pre-school children, the prevalence of underweight and wasting follow similar regional patterns to the prevalence of stunting. Estimates for prevalence of underweight pre-school children in different regions of Africa in the year 2000 range from 14 to 36.5% underweight; Asia 28.9 to 43.6% and Latin America and the Caribbean 3.2 to 15.4%^f. Although estimates of prevalence of wasting are not available for all sub-regions, overall estimates for wasting in preschool

^bStunting, underweight and wasting refer to <-2 z-scores of the NCHS reference median for height-for-age, weight-for-age and weight for height respectively unless otherwise indicated.

^cEstimated prevalence and number of stunted pre-school children for year 2000. de Onis, Frongillo & Blossner, 2000 (WHO Global Database on Child Growth and Malnutrition, 2000)

^dIbid

^eIbid

^fEstimated prevalence and number of underweight preschool children for year 2000. (WHO Global Database on Child Growth and Malnutrition 2000: Forecast of Trends).

^gPrevalence of wasting in preschool children for 1995. de Onis and Blossner, 2000 (in WHO Global Database on Child Growth and Malnutrition, 2000.)

^hLow-birth-weight infants are more likely to become stunted children. Stunted children tend to become stunted adults and, stunted females of childbearing age tend to have low-birth-weight infants (SCN 1997).

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children by region are available for 1995: Africa 9.6%, Asia 10.4% and Latin America and the Caribbean 2.9%^g.

SCHOOL CHILDREN: Stunting is widely believed to occur mainly in early childhood (mostly by three years of age), and through a cumulative process. Children stunted at school-age are likely to have been exposed to poor nutrition since early childhood and the degree of stunting tends to increase throughout the school-age years. However, children can exhibit catchup growth if their environment improves^h. This suggests that interventions in school-age children can supplement efforts in the preschool years to reduce levels of stunting and related effects on children's health and education.

Underweight among school-age children, like stunting, can reflect a broad range of insults such as prenatal undernutrition, deficiencies of macro- and micro-nutrient, infection and, possibly, inadequate attention by care givers. Wasting, which reflects acute malnutrition, is not as common as either stunting or underweight in school-age children. Nevertheless, wasting rates can change rapidly in situations of acute food crisis, with school-age children, adolescents in particular, becoming severely malnourished in such situations.

Recent studies on school-age children have shed new information on stunting, wasting and underweight for this age group:

□ one of the largest studies⁵ of anthropometric status of rural school children in low income countries (Ghana, Tanzania, Indonesia, Vietnam and India) found the overall prevalence of stunting and underweight to be high in all five countries, ranging from 48 to 56% for stunting and from 34 to 62% for underweight. Second, in all countries there was a trend for z-scores^h for height-for-age and weight-for-age to decrease with age, thus as children got older they became progressively shorter relative to the reference population. Third, the boys in most countries tended to be more stunted than girls and in all countries boys were more underweight than girls;

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□ a longitudinal study of changes in height and weight of school-age children on Pemba Island, Zanzibar⁶ showed the prevalence of stunting increased with age (14% prevalence in seven year olds increasing to 83% in 13 year olds) and peaked in girls at age 12 then declined when they entered their pubertal growth spurt. In boys, however, the prevalence of stunting rose steadily up to age 13 years and then slowly declined. Boys accumulated a height deficit of 11.9cm and girls a height deficit of 8.5cm compared to the reference population⁶

□ a recent cross sectional survey of the nutritional status of adolescent boys and girls in Bangladesh found that 67% of adolescents were thin (BMI < 5th percentile of WHO reference) and 48% were stunted (defined as height-for-age <5th percentile of the NCHS and WHO reference data). Whereas, thinness was found to decline in prevalence with age from 95% at age 10 years to 12% at age 17 years, the prevalence of stunting increased from 34% at age ten years to 65% at age 17 years⁷. Stunting was also found to increase with age in a second study with younger girls reported to have a prevalence of just 2% stunting while 16% of older girls were stunted^{1,8}

□ a study in Brazil of the gender differences in growth of school-age children suffering from helminth infections found that 21% of school-age children were stunted and 13% were underweight. Both indices of nutritional status worsened as the study population got older, particularly for boys. The later onset of puberty and the growth-spurt in boys was controlled for in the growth data analysis, but boys remained significantly more malnourished than girls⁹

□ in a recent prospective cohort study of school-age children in Bangladesh, diarrhoea was found to retard weight gain and slow linear growth, although respiratory infections did not have the same effect¹⁰

□ another study from an impoverished rural area of Guatemala that had recently benefited from a poverty alleviation

programme, identified sanitation and housing conditions as risk factors for growth faltering in school-age children. Adult women's body mass index was also identified as a risk factor for stunting in school-age children¹¹

□ three recent studies from Chile also link growth deficits in school-age children to socio-economic conditions:

- in a cross sectional study of indigenous Chilean school children, improved social conditions were related to improved growth, but this was not observed among the non-indigenous school children¹²
- a case control study identifying the risk factors of short stature among Chilean children entering school, reports similar risk factors associated with short stature (and poverty) independent of parents' heights, suggesting that genetic factors have limited impact on height at this age¹³. The authors conclude that in countries similar to Chile, in order to decrease the prevalence of growth deficits, reducing poverty and its consequences is critical¹⁴
- another cross sectional study from Chile concluded that the higher prevalence of stunting among an indigenous population of Mapuche school children was not genetic, but reflected socio-economic conditions¹⁴. The study found no significant differences in growth deficits among school children of Mapuche ancestry compared to non-Mapuche ancestry within poverty levels¹⁴.

□ the severity and prevalence of stunting and underweight have been found to increase with age, with older children diverging further from the reference medians for height until puberty. The evidence suggests that boys are more likely to be stunted and underweight than girls, and in some countries, more likely to be wasted than girls^{7,5}. This may be due to a bias in the school population. It is also suggested that it could reflect delayed onset of puberty;

⁵Standard deviations about the mean

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□ it appears that although children (of both sexes) show evidence of growth into late adolescence, full 'catch-up' growth is not occurring and linear growth retardation persists throughout the school years. Non-intervention studies of catch-up growth in children show moderate levels of improvement, with 25-32% of the children stunted at age 2 years no longer stunted by school-age or pre-adolescence^{15,16}

□ in another longitudinal study, comparing pre-school stunting to stunting in adolescence, stunted girls exhibited a significant delay in sexual maturation and showed evidence of catch-up growth between the ages of five and 17 years¹⁷. The girls' delay in sexual maturity demonstrates that stunted children of both sexes have the possibility of catch-up growth after age 17 years. The stunted girls on average had a 1.6 year delay in menarche compared to the tallest girls¹⁷

□ in a study from rural Bangladesh, menarche was associated with better nutritional status as indicated by significantly higher mean heights (in menstruating girls ages 11-14 years) and weights (in menstruating girls ages 13-15 years) compared to non-menstruating girls of the same ages¹⁸

□ evidence suggests that in adolescence, children in deprived environments grow as much, or more than the NCHS reference population and that during the childhood period, tremendous variation in growth exists between populations¹⁹

□ in Chile, a country undergoing the 'nutrition transition', height deficits have been compared between children entering first grade in 1987, 1990, 1993 and 1996. Overall, height deficits have declined in both boys (from 10.6% in 1987 to 7.3% in 1996) and girls (from 7% in 1987 to 5% in 1996), although the overall height deficit in boys was found to be greater than for girls in each period studied. Stunting was found to increase with age: 2.2% of 5-6 year olds were stunted compared to 13.1% in children over 8 years old²⁰; and

□ rather large height deficits can accumulate during the relatively long childhood period of about 8 years. Whilst growth can be improved during the childhood period, growth improvements observed in studies of one year or less duration have been disappointing¹⁹. Longer-term interventions need to be conducted to determine if gains in growth can be sustained long enough to become significant.

Previous health research on the school-age group was school-based and focused primarily on enrolled children; little was known about the health and nutritional status of out-of-school children. From the mid-90s several studies have focused on the health status of out-of-school children:

□ one study in Ghana compared the health of enrolled and non-enrolled children in primary school and showed that there were considerable differences between enrolled and non-enrolled children²¹. Non-enrolled children of both sexes were significantly smaller in height than enrolled children of the same age range. Just over half (51%) of children aged six to seven years who were not enrolled in primary school were stunted in comparison with only 19% who were enrolled in school. It is likely that many of the chronic health problems encountered in the six to seven year old children studied are the product of disease and poor nutrition before they enrolled in school.

Important questions are raised from these studies that reflect the need for more information on the patterns and determinants of growth in this age group. First, it is important to identify whether the height deficits accrued during the primary school years are made up through longer pubertal growth and at what stage boys and girls stop growing in height. Second, the functional implications of linear growth retardation in school-age children needs to be more clearly understood. Third, the question as to what extent school-age stunting is preventable through school-based interventions needs to be addressed⁶.

Impact of Undernutrition on Children's Education The studies of the effect of

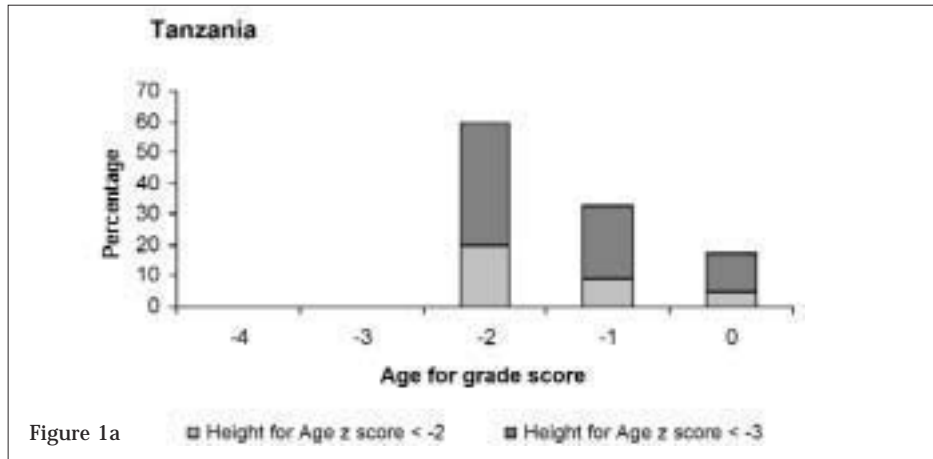


Figure 1a

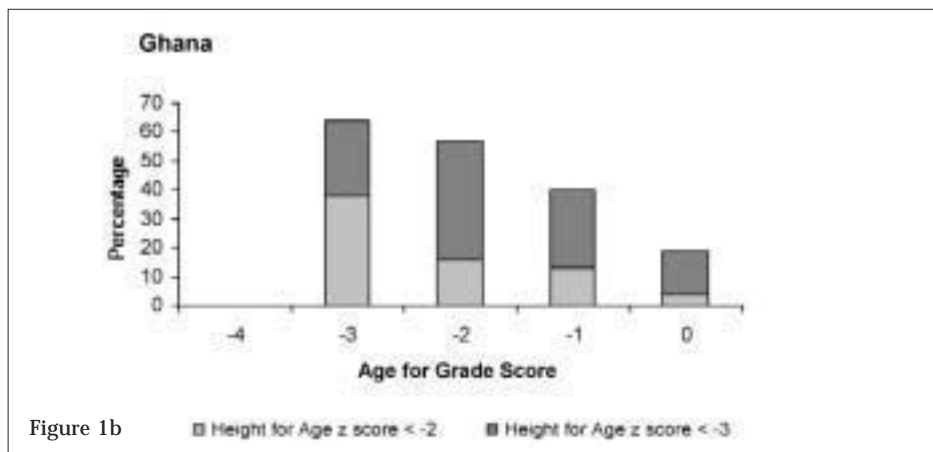


Figure 1b

undernutrition on cognitive ability although not entirely conclusive, indicate that chronic undernutrition is associated with lower achievement levels in school children²².

Recent studies have found:

- that severe stunting in the first two years of life is strongly associated with lower test scores in school-age children (age 8-11). However, deficits in children's scores were smaller at older ages, suggesting that adverse effects may decline over time. In addition, lower test scores were related to later enrollment, increased absenteeism and repetition of school years among stunted children. These findings indicate that stunted and non-stunted children can

benefit similarly from education²³

- a negative association between indicators of chronic malnutrition and language and mathematics test scores in a cross sectional study of 3,055 Vietnamese school children when indices of malnutrition to educational test scores were compared²⁴; and

- short stature has been associated with late enrollment for primary school children in Ghana and Tanzania (Figure 1a and 1b)²⁵.

Micronutrient Deficiencies

Nutritional anaemia, particularly deficiencies of iron, iodine, and vitamin A are major problems for school-age children in low

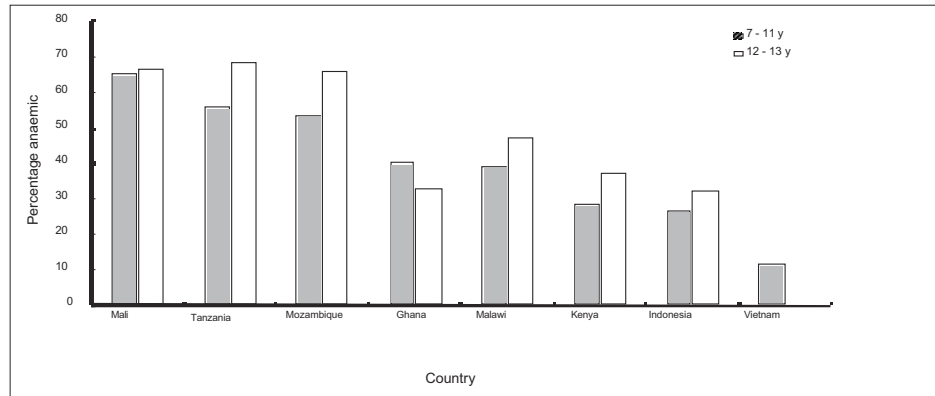


Figure 2 Prevalence of anaemia in school-age children in eight countries in Africa and Asia
 Source: *Partnership for Child Development, 2001a.*

income countries. It has been shown that such deficiencies can negatively impact on growth, increase susceptibility to infection and also impair the mental development and learning ability of school children.

IRON DEFICIENCY AND ANAEMIAⁱ: Iron deficiency (ID) is the most common nutritional disorder in the world and is estimated to affect more than 2b people of whom 1.2b suffer from iron deficiency anaemia (IDA)^{26, k}. Insufficient intake of iron rich foods is the major cause of ID. It can also be caused by parasitic infections (particularly hookworm and malaria) and deficiencies of other nutrients^{27,28,29}.

There is little evidence to suggest any recent decrease in the prevalence of anaemia³⁰. It is estimated that 53% or 210m school-age children suffer from IDA^{31,32}. The highest

prevalence is reported in Asia (58.4%) followed by Africa (49.8%)³³.

Recent studies and surveys have tried to capture the prevalence of IDA in school children:

□ in a survey of nearly 14,000 rural school children in Africa and Asia, the prevalence of IDA was more than 40%^l in five African countries (Mali, Tanzania, Mozambique, Ghana, and Malawi) amongst children aged 7-11 years and in four African countries amongst children aged 12-14 years. In the two Asian countries studied, the overall prevalence of IDA was found to be considerably lower than in Africa (around 12% in Vietnam and 28% in Indonesia among 7-11 year olds). Children aged 7-11 years were found to have lower mean haemoglobin concentrations, while IDA was found to be more common in the older age group. Girls were also found to have lower haemoglobin concentrations than boys, although the overall prevalence of IDA was higher in boys, particularly in the 12-13 year age group (Figure 2.). An association between late enrollment in school, as compared to enrolling closer to the correct age, and a higher prevalence of anaemia was also found³⁴

□ an in-depth survey of 2,998 children ages 8-9 and 12-13 years in Ghana and Tanzania revealed that 77% of children in Tanzania

ⁱThe major work carried out in the field of adolescent nutrition previously was a study of 11 developing countries conducted in 1994. Anaemia and stunting were found to be the largest nutritional problems.

^kThe diagnosis of anaemias in school-age children is complicated because different thresholds apply to the four different age and sex categories within the school-age population.

^lTwo thirds of the body iron is functional iron, mostly haemoglobin (Hb). The three stages of iron reduction are: 1) iron depletion measured by a reduction in serum ferritin which is not related to functional impairment, 2) iron-deficient erythropoiesis which is referred to as iron deficiency (ID) without anaemia and 3) iron-deficiency anaemia (IDA), the most severe level of iron deficiency.

and 41% of children in Ghana were suffering from IDA²

□ in a study of 1,210 primary school girls aged 7-14, in Riyadh, Saudi Arabia, an anaemia level of 55.4% was found. The highest level (71.4%) was found among 14 year-old girls³⁵

□ in a study of adolescent males and females in Bangladesh, extremely high levels of anaemia were identified in both females (98%) and males (94%)^m. At age 17, 100% of females were anaemic⁷, and

□ in a survey of 6,486 adolescent students (12-15 years) in East Java, Indonesia, anaemia levels of over 25% in girls, 24% in pre-pubertal boys and 12% in pubertal boys were detected. Higher levels of anaemia were found among adolescents of lower socio-economic status. In this study as well, puberty increased the risk of anaemia among girls³⁶.

There is substantial evidence that IDA in children is associated with decreased physical development, impaired immune function, poor growth and increased fatigue. IDA also affects cognitive function and school achievement (a comprehensive review is provided by Grantham-McGregor and Ani, 2001)²². In addition:

□ in Thailand, large differences were found between school children with anaemia and/or iron deficiency and iron replete children in their performance on a Thai language test and a test of general reasoning ability, yet not in arithmetic scores³⁷

□ Soemantri (1985) found smaller differences between Indonesian school children with IDA and iron replete children in their performance on a range of school exams, although the children did not differ in a test of concentration. Both exam performance and concentration was improved by iron supplementation³⁸

□ iron supplementation improved the

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performance of Indian school children on tests of memory and visual/motor coordination³⁹.

IMPACT OF SUPPLEMENTATION ON IDA: The main focus of IDA reduction programmes has been young children and women of reproductive age. Recent studies have emphasized the high prevalence of iron deficiency and anaemia in school-age children. This has resulted in an increased programmatic response for this age. However, there is conflicting evidence concerning the beneficial effect of iron supplementation on growth in children. Some studies have shown that daily supplementation improves growth and appetite, while others have not found any beneficial growth response:

□ results from one study indicate that four months of daily supplementation with 3 mg ferrous sulphate per kilogram of bodyweight of non-iron replete, non-anaemic children results in decreased weight gains⁴⁰

□ a recent review study of infants, pre-school and school children concludes that iron supplementation has significant impact on the linear growth in anaemic children⁴¹

□ a case-control study of the effects of providing weekly doses of 400 mg of ferrous sulphate for three months on the iron status and growth of adolescent schoolgirls in Tanzania was conducted. Weekly iron supplementation was found to result in a significant increase in serum ferritin (but not haemoglobin) and a significant increase in weight gain compared to adolescents given a placebo. No gain in height was found⁴²

□ in a randomised controlled trial of non-anaemic school-age children receiving 3mg ferrous sulphate per kg bodyweight or a placebo, weekly for 18 weeks, the treatment group did not show any significant change in haemoglobin, however the control group showed a significant decrease in haemoglobin concentrations. Changes in weight were not significantly different between the treatment and control groups. In this study, weekly iron supplementation of non-anaemic school-age children

^mAn IDA prevalence of >40% is defined by WHO as a severe public health problem

prevented significant decreases in haemoglobin without negatively effecting weight⁴³.

In recent years, a number of studies have suggested that weekly iron supplementation is as effective as daily supplementation in raising haemoglobin levels, however, there is still a need to further assess the effectiveness of weekly supplements under programme conditions to ensure that compliance is achieved. Other studies show:

□ findings from a study of school children in Bolivia suggest that iron supplementation (3-4mg/kg ferrous sulphate) for five days per week is as effective as weekly supplementation over the course of 16 weeks⁴⁴

□ a recent study in 60 non-formal schools in Mali found that supplementation with 65mg iron and 250 µg folic acid weekly for 10 weeks improved haemoglobin concentration by 3.9 g/L in comparison with a placebo group⁴⁵. All children were given deworming treatment and vitamin A supplements prior to the trial;

□ one of the few studies from Africa that has examined the impact of weekly supplementation with 400mg of ferrous sulphate for four months on the iron status and growth of adolescent schoolgirls found a significant increase (>50%) in serum ferritin levels in the group receiving iron supplements⁴²

□ a study of reducing anaemia in adolescent schoolgirls in Peru tested both daily and intermittent iron supplementation (60mg of ferrous sulphate) over a 17 week period. It was found that while both supplementation schedules resulted in improved iron status, daily supplementation resulted in the greatest increase in haemoglobin concentration and significantly reduced the prevalence of anaemia⁴⁶

□ an experimental community trial was conducted to observe the effect of a communication programme on compliance with weekly iron supplementation (65 mg elemental iron + 250 µg folic acid) in urban

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Tanzanian adolescent schoolgirls. A total of 237 girls, aged 14-17 were randomly recruited from five schools. Girls in schools 1 and 2 received iron and folic acid tablets weekly for eight weeks and weekly communication sessions, school 3 received the same supplement without the communication sessions and schools 4 and 5 served as the control schools. In the group receiving supplementation and communication, the prevalence of anaemia decreased significantly. The prevalence of anaemia did not change significantly in schools 3 and 4 but increased significantly in school 5. The observed compliance in the schools receiving the communication sessions was 75 and 94% compared to 50% in the school without the communication sessions. These results suggest communication strategies can influence compliance with iron supplements and thus help to reduce anaemia in adolescents⁴⁷; and

□ studies from Indonesia⁴⁸ and Malaysia⁴⁹ have demonstrated improvements in the iron stores of adolescent schoolgirls supplemented once weekly. In the Indonesian study, the group who received retinol along with the iron supplement benefited most in terms of increased iron stores.

IODINE DEFICIENCY AND IODINE DEFICIENCY DISORDERS (IDD): Iodine deficiency affects an estimated 1.6b people worldwide and estimated 60m school-age children. The consequences of iodine deficiency include severe mental retardation, goitre (a condition involving the enlargement of the thyroid gland and a disruption of normal thyroid production), hypothyroidism, abortion, stillbirths and low birthweight and mild forms of motor and cognitive deficits.

Recent studies in school-age children have found very high levels of goitre and iodine deficiency. School-age children are often the target population of IDD assessments because of their physiological vulnerability and their accessibility. Examples are:

□ recent studies of IDD in school children have been carried out in Egypt, Swaziland

and South Africa. Overall prevalence rates of between 35 and 70% have been found indicating a severe public health problem in each of the areas studied^{50,51,52}

□ in Calcutta, India, after having implemented a universal iodized salt programme for several years, a monitoring survey reported 23% of male school children and 32% of female school were moderately to severely iodine deficient⁵³.

IMPACT ON CHILDREN'S MENTAL DEVELOPMENT & EDUCATION: Iodine deficiency is the leading cause of preventable intellectual impairment worldwide. A number of studies comparing children living in iodine-deficient areas with those living in iodine sufficient areas have found that the iodine deficient children have poorer levels of cognitive development and school achievement⁵⁴:

□ observational studies carried out over the past 30 years (reviewed by the Partnership for Child Development, 1996)⁵⁵, have found that school-age children living in iodine-deficient areas have lower IQs and poorer cognitive and motor function than school-age children living in iodine-sufficient areas;

□ in a study of school-age children suffering from mild and moderate iodine deficiency in Bangladesh, it was found that hypothyroid children performed worse than normal children in reading and spelling⁵⁶

□ a study of the association between hypothyroidism and cognitive and motor function and school achievement in Bangladeshi school-age children found that the hypothyroid children performed worse in reading and spelling than non-hypothyroid children. These differences were observed after controlling for biological, socio-cultural and socio-economic conditions. In addition it was found that stimulation and the availability of materials were also significantly associated with improved reading, spelling and mathematics. This study concluded that children suffer a range of disadvantages in addition to iodine deficiency and if they are to benefit fully from education, a comprehensive approach

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to their health and nutrition problems is needed⁵⁶; and

□ in Benin, a randomised control trial was implemented on an iodine-deficient population of 196 school children. Due to the availability of iodized salt to the study population during the intervention, participant results were split post hoc based on improved iodine status measured in urine samples. Results indicate that children with improvements in urinary iodine status (from capsules or iodized salt) had significantly better test scores, particularly on tests of abstract reasoning and verbal fluency compared to children without improvements in iodine status. As the tests included time limits for response, these findings may indicate an improvement in the level and or speed of task performance. These results may indicate a "catch-up" effect as well. The group of children whose urinary iodine concentrations were unchanged during the intervention showed less progress even though their iodine status was, on average, better than the improved group both initially and at the end of the study⁵⁷.

Universal iodization of salt is seen as the permanent and sustainable solution to the global IDD problem. Iodization of salt is the preferred approach for supplementation in iodine deficient populations. It is now mandatory for manufactured salt to be iodized in most countries, however, this does not guarantee the elimination or reduction of IDD. In many countries a persistence of goitre in school children is being observed despite near universal iodized salt consumption.

In areas where iodized salt is not available and where the prompt correction of IDD is urgent, iodized oil can be administered to school children inexpensively and simply, maintaining iodine levels for a period of twelve months. For example:

□ in Guatemala where the purchase of iodized salt has been problematic, IDD education through schools has been piloted. It was found that a participatory education module appeared to result in an increase in the purchase of iodized salt at the household

level⁵⁸

□ in South Africa, where mandatory iodization of salt was introduced in 1995, a study of the effects on school children in an endemically goitrous area after one year found that iodine deficiency was virtually eradicated. The overall goitre rate, however, did not decline⁵⁹

Little is known about the occurrence

□ in China, a randomised clinical trial was implemented comparing iodine interventions in 205 school children aged 8-10 with low to moderate levels of iodine deficiency. Group A was provided iodized salt with an iodine concentration of 25 ppm; groups B and C purchased iodized salt from the market, while group C was provided with an iodized oil capsules at the beginning of the study. The salt iodine level for group A was stable, however for group B and C the salt iodine levels ranged from 13-47 ppm. The children in Groups A and C responded more quickly than group B, with a higher percentage decline in iodine deficiency, as measured in abnormal thyroid volumes⁶⁰; and

□ in a recent trial conducted in an area of endemic goitre, the response of oral iodine supplementation in anaemic and non-anaemic goitrous children was compared. In the children with iron deficiency anaemia their response to oral iodine was impaired⁶¹. The results of this study suggest that iron deficiency anaemia in children limits the effectiveness of oral iodine supplementation.

VITAMIN A DEFICIENCY (VAD): Mild or sub-clinical VAD⁶² causes impaired immune function, increased severity of some infections and an increased risk of mortality from infectious diseases and is widely recognised as an important cause of blindness in children. It is estimated that 85m school-age children are at increased risk of acute respiratory and other infections

⁵⁸A plasma retinol concentration <10µg/dl and <20µg/dl are cut-off values defined by WHO for severe and marginal deficiency respectively

⁵⁹Personal communication, A. Hall, Country Director, Helen Keller International, Bangladesh.

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because they are deficient in vitamin A⁶². VAD also affects iron metabolism so that with any iron supplements taken, subsequent improvement in iron status may be limited when vitamin A status is low.

School-age children have not been considered an 'at-risk' group for VAD in the past. Little is known about the occurrence or effects of VAD in this age group.

However, the small number of recent studies conducted, suggest that VAD is a public health problem in school-age children:

□ in Bangladesh, which achieves vitamin A supplement coverage of over 90% in under fives, evidence suggests that VAD may be a larger problem among school-age children than pre-school children⁶³. An article reviewing VAD studies in Bangladesh noted that although the extent of clinically evident VAD among school-age and adolescent children has decreased slightly in the last two decades, it remains a significant problem, with deficiency levels higher in boys than girls⁶³. Working adolescent girls from urban areas appear to be the most severely affected group⁶³

□ in Bangladesh, a study of adolescent health and nutrition status found that 2.1% of the children surveyed had eye changes (conjunctival xerosis and Bitot's spots), indicating severe VAD⁷

□ a study of the effect of micronutrient-fortified biscuits on the nutritional status of primary school children from South Africa, found that 40% of the children had sub-clinical VAD⁶⁴

□ a second study of the effect of providing fortified soup to school children in South Africa found that between 23.7% and 46.7% of children were marginally vitamin A deficient (<30µg/dL)⁶⁵

□ in Mexico, almost half of school children surveyed were found to be deficient in vitamin A, and over 6% had low serum retinol levels (<0.35mol/L)⁶⁶

□ a study of the relationship between serum retinol concentrations and helminth infection among primary and pre-school children in South Africa found that 23.5% had low serum retinol concentrations⁶⁷

□ a recent assessment of the vitamin A status of school children in Tanzania, Ghana, Indonesia and Vietnam found that that VAD was a severe public health problem in Tanzania (30% deficient in vitamin A), a moderate problem in Ghana and a mild problem in Indonesia and Vietnam according to WHO criteria⁶⁸

□ in Cameroon, a study of the relationship of the effect of the parasite, *Onchocerca volvulus* on plasma vitamin A levels in 261 school children reported sub-clinical vitamin A deficiency in over 80% of the children. Children with onchocerciasis had significantly lower vitamin A concentrations in their plasma compared to children without infections⁶⁹

□ a recent study of the prevalence of vitamin A deficiency in northern Ethiopia among 824 school-age children reported a xerophthalmia rate of 5.8%. Serum retinol concentrations were deficient in 8.4 and low in 51.1% of the children. A significant difference was noted between sexes only in vitamin A reserves; girls had significantly lower vitamin A reserve than boys⁷⁰

□ in a recent cross sectional study of anthropometric indices, micronutrient status and prevalence of parasite infections of 579 school children (8-10 years old) in KwaZulu-Natal, South Africa, vitamin A deficiency levels of 37.7% (serum retinol < 20 ug/dl) was found⁷¹; and

□ a case control study involving 105 children with night blindness in rural Bangladesh found that affected children were 5.4 times more likely to have a low mid upper arm circumference, indicative of protein energy malnutrition, and associated with a low intake of low intake of beta-carotene-rich and vitamin A-containing foods as well as with low serum vitamin A.

Food-based approaches, including

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fortification, are the preferred long term strategy to prevent VAD. However, for the short term, providing vitamin A supplements, multiple micronutrient supplements or vitamin A fortified foods to school-age children may be effective strategies to prevent VAD in this population.

In the Philippines, a randomised double-blind, controlled trial evaluating the effect of a vitamin-A fortified wheat flour bun was implemented with 835 children ages 6-13 attending four rural schools. The children in the experimental group consumed buns five days a week for 30 weeks fortified with 33% of the RDA for vitamin A. Results were stratified based on initial serum retinol levels. The children with marginal-to-low initial serum retinol levels significantly improved their vitamin A status with daily consumption of vitamin A-fortified buns. These results suggest that fortified foods can improve vitamin A status in deficient school-age children⁷².

MULTIPLE MICRONUTRIENT DEFICIENCIES: Single micronutrient deficiencies seldom occur in isolation, but instead, interact and tend to cluster. For example, iron deficiency and VAD often coexist in the same populations (see below). Providing vitamin A supplementation can both improve vitamin A status, as well as, iron metabolism in deficient populations. Further, vitamin A food fortification programmes produce similar results.

School-age children, like most populations in low income countries, suffer from multiple micronutrient deficiencies. Data are not available on the extent of the problem in school-age children. However, inference can be made from data on pre-school children; 13 to 27% of pre-school school children are estimated to have two or more micronutrient deficiencies suggesting that 100m pre-school children are affected³⁰.

Given the frequent overlap and clustering of micronutrient deficiencies, multiple micronutrient supplementation or fortified foods may be a cost-effective strategy to address nutrient deficiencies in school-age children, in addition to synergistic effects

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between certain micro-nutrients. For example:

□ in one study in China, children supplemented with zinc and other micro-nutrients had the largest improvements in growth and cognitive function; growth improved with micronutrient supplementation, but showed little change with only zinc supplementation⁷³. These results are consistent with other studies and suggest that deficiencies of other micro-nutrients can suppress the growth response after zinc repletion;

□ in a recent study of the relationship between vitamin A, iron status and helminth infection among Bangladeshi school children, children with low serum retinol levels had significantly lower ferritin and haemoglobin levels that those with higher serum retinol levels⁷⁴

□ in a randomised double-blind control trial with 830 primary school children from Tanzania, the odds of stunting were significantly reduced by provision of a micronutrient-fortified beverage. Anaemia was reduced nearly by half in the intervention group as well⁷⁵. The children drank one serving of the beverage, fortified with 30-120% of the RDA for several micro-nutrient for six months on each attended school day;

□ in Tanzania, a randomised controlled trial of the effects of dietary supplements on anaemia, and on the weight and height of 136 anaemic school children from low socio-economic backgrounds was conducted. The supplements were administered for three months in local corn meals. Although vitamin A supplementation increased haemoglobin levels and growth parameters significantly, the group of children who received the combined vitamin A and iron supplements had the greatest improvements compared with the placebo group in all indicators. The low cost and simplicity of this study suggest that vitamin A and iron supplementation have a role in the prevention of IDA and growth retardation⁷⁶

□ a randomised, double-blind, controlled study of the effects of dietary supplements on anaemia in teenagers was conducted in urban Bangladesh. Participants were provided weekly supplements for 12 weeks. Compared with the placebo, the iron, folic acid and vitamin A supplement reduced anaemia by 92%, iron deficiency by 90% and vitamin A deficiency by 76%. For young women not deficient in vitamin A, there was not a significant difference in the response of haemoglobin to iron than to iron plus vitamin A. Those with the lowest baseline haemoglobin had the greatest increase in haemoglobin⁷⁷

□ giving micronutrient deficient school children in South Africa biscuits fortified with iron, iodine and beta-carotene has been shown to significantly improve their micronutrient status. The prevalence of low serum retinol concentrations decreased from 39.1% to 12.2 %, anaemia declined from 27.8% to 13.9% and low urinary iodine concentrations declined from 97.5% to 5.4%. The biscuit was given in the morning for a period of 215 days at a cost of just US\$0.7 per child, per school year⁶⁴

□ in a case-control study of 66 school children (aged 10-12) in India, those identified as deficient in iron and vitamin A were fed biscuits made with cauliflower leaf powder (a source of iron and vitamin A) for a period of four months. After the intervention, the experimental group had significantly higher haemoglobin and serum retinol levels. Initially 27.27% of children in the experimental group had normal nutritional status compared to 42.42% post intervention⁷⁸; and

□ in a randomised control trial of the effect of anthelmintic treatment and micronutrient fortification in 579 South African school children aged 8-10 years, children were randomly allocated into six study groups, half who received anti-helminthic treatment at baseline. Each of the two groups were further divided into three groups and given biscuits (for 16 weeks)

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either unfortified, fortified with iron, or fortified with iron and vitamin A. There was a significant treatment effect of vitamin A on serum retinol levels, as well as a suggested additive effect between vitamin A fortification and de-worming, i.e. vitamin A supplementation with de-worming had a greater effect on vitamin A status than vitamin A fortification alone. At baseline 34.7% of the children were vitamin A deficient and 15.5% were anaemic. Significant cognitive treatment effects were not found in either of the groups that received biscuits fortified with multiple micro-nutrients. The impact of this intervention may have been limited by its short duration (16 weeks), low burden of micronutrient deficiency and low prevalence of stunting in the study population⁷⁹.

Overweight and Obesity

Overweight^p and obesity is becoming increasingly prevalent in low income countries where improvements in socio-economic conditions and rapid urbanization are causing a 'nutrition transition'. A rapid shift in the composition of diet (higher fat and lower carbohydrate), reduced activity patterns and a subsequent shift in body composition characterise this transition.

Countries undergoing a 'nutrition transition' have high levels of stunting, which is believed to be a risk factor for obesity. This may be explained by the relationship of stunting to undernutrition. Evidence from animal and human studies suggests that with malnutrition in utero and in early life, endocrine development may be affected, resulting in hormonal alterations and a predisposition to metabolic disorders and obesity^{80,81,82}. It is suggested that the increased risk of obesity among stunted children will lead to considerable problems with obesity in children in low income countries over the coming decades^{83,84}.

Although there is a growing body of data on obesity and overweight in this age group, few data are available on the true extent of

overweight among school-age children in low income countries. Nationally representative data are lacking and few countries have repeated surveys, thus trend data are limited. Furthermore, there are methodological concerns: the use and interpretation of weight-for-height indices based on children from the US has been questioned in populations with significant levels of stunting⁸⁵.

In 1995, an estimated 17.6m children in the low income countries were overweight⁸⁶. The overall prevalence of overweight in the pre-school population is low, at 3.3%⁸⁶. Available data suggest that the problem of obesity begins in preschool children, becoming more evident among school-age children⁸⁵. In Sub-Saharan Africa and in South Asia obesity is rare. However, in the more developed countries of Latin America, the Middle East, Central Eastern Europe, the Commonwealth Independent States and North Africa, obesity is as prevalent as in the United States. Northern Africa and Central America, areas undergoing rapid nutrition transitions, have both problems of stunting and overweight among children.

In school-age children, the following has been observed:

□ in Chile, 20.7% of school-age children were reported to be overweight and 13.5% obese in 1995²⁰

□ a study of school-age children (and pre-school-age) in four countries undergoing the nutrition transition (Russia, China, Brazil and South Africa) found that the prevalence of child overweight ranged from 10.5% to 25.6% (weight-for-height at or above the 85th percentile). Boys in Russia have an overweight prevalence comparable with boys in the US (11.8% >95th percentile). Stunting is also common in these countries affecting between 9% and 30% of all children and a significant association was found between stunting and overweight status in all four countries⁸³

□ from China, urban-rural combined data comparing the level of overweight school children from 1991 to 1995 indicate

^pOverweight is defined as BMI (body mass index) between the 85th and 94th percentiles, and obesity is defined as, at or above the 95th percentile of the NCHS/CDC BMI-for-age percentile curves, (Barlow and Dietz, 1998)

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increases of 6 to 9.8% for boys and 5 and 7.6% for girls over this time period. Increases in dietary fat intake and lower levels of physical activity have been attributed to the increasing levels of obesity⁸⁷

□ in a study of nutritional status of Kuwaiti elementary school children (6-10 years old) the level of obesity (defined as z-scores >2) was significantly higher for boys (15.7%) than girls (13.8%). Stunting was found to be higher in boys as well, 9.5% compared to 4.6% in girls. In comparing results of this study (1995) to a previous study (1985), obesity levels have increased significantly from 12.9% to 21.9% (above the 95th percentile weight-for-height)⁸⁸. In the US, 13% of similarly aged children (6-11 years old) were above the 95th percentile⁸⁹. These results indicate that Kuwaiti school children have a higher prevalence of obesity than US school children;

□ in a study of an urban low-income population in Brazil, although wasting (10.2%) was the most prevalent form of malnutrition, adolescent girls had stunting levels of 11% and an obesity rate of 5.5%. Girls suffered more from stunting and overweight/obesity than boys did. These results suggest that improved living conditions in urban areas in populations 'adapted' to chronic food shortages may increase the susceptibility to obesity⁹⁰

□ a representative study of 10 to 13 year old school children from both private and public schools in the urban area of San Jose, Costa Rica found that the prevalence of overweight was similar in both groups, with 31% overweight (85th to 94th percentile BMI reference curves). These findings suggest that overweight is equally a problem among children from lower income families as among children from families with higher incomes⁹¹

□ in a cross sectional study of school children 9 to 16 years old from a low to middle income town in the Mexico City area, found that 24% of the children were obese (defined as >85th percentile BMI reference

curves). Television viewing was associated with an increased risk for obesity, a 12% greater risk for each additional hour of daily TV viewing was estimated. Participating in physical activity, particularly vigorous physical activity was found to protect against obesity⁹²; and

□ a longitudinal study of 2,252 primary and secondary school children in Hat Yai, an urban area in Thailand, found that overweight in males increased from 12.4% in 1992 to 21% in 1997, however, the percentage of overweight in females decreased from 15.2% to 12.6%. Over the 5-year period of the study, children who were overweight during childhood were 12 times more likely to be overweight during adolescence than their non-overweight classmates. A family history of obesity, a monthly income greater than 5,000 baht, a low exercise level and one or more parents with a high BMI level were associated with overweight tracking. This study supports the importance of early intervention to prevent the persistence of overweight into adolescence and adulthood⁹³.

Short Term Hunger and School Nutrition Programmes (SNP)

There is increasing evidence of the negative consequences for children suffering from short term hunger, particularly in children who are not fed before going to school. Children who are hungry are more likely to have difficulty concentrating and performing complex tasks, even if otherwise well nourished⁹². In recent years there has been some doubt about the value of stand-alone school feeding programmes in terms of their impact on either nutrition or education. However, the value when implemented in the right context should not be underestimated.

In 2000, a School Feeding/Food for Education stakeholders meeting brought together top practitioners and experts from USAID, USDA, the World Bank, UNICEF and other organisations who either administer or implement SNPs⁹⁴, who reviewed the current situation. Some of the main conclusions of

School Feeding/Food for Education Stakeholders Meeting, October 2000

Lessons related to the rationale for school feeding programmes:

- ❑ Nutritional benefits: There is little evidence to suggest that school feeding programs have a positive impact on nutrition for participating children. In some instances, parents may provide less food at home, and the school meal simply replaces a home meal rather than adding food to the child's diet.
- ❑ Impact on education and the link between hunger and learning: Much evidence suggests that children who are hungry or chronically malnourished are less able to learn, regardless of the setting. But the converse – that children in school feeding and food for education programmes are better able to learn – only holds true when the food is accompanied by other inputs related to school quality.
- ❑ Impact on attendance: The evidence strongly suggests that school feeding programmes can increase attendance rates, especially for girls. School feeding or take-home rations serve as incentives for enrolling children in school and encouraging daily attendance. This is likely a short term solution, however, because if there is no change in the quality of schooling (or increase in intrinsic demand for education) attendance will likely drop once the food incentive is removed.

Programmatic lessons learned:

- ❑ Relationship to education reform: School feeding must take place within the context of broad, national school reform programmes. These reforms should focus on other essential inputs to education and learning such as teacher development, curriculum reform, and student assessment.
- ❑ Burden on governments and education ministries: National ministries of education should not be encouraged to 'take on' school feeding at the expense of the other educational inputs, as it is difficult politically to refuse food aid.
- ❑ Working through communities: Getting the community involved from the beginning, and giving them ownership of school feeding programmes greatly increases the chances for the programme's success and sustainability.
- ❑ Complementary inputs: To overcome the reliance on outside food sources such as school feeding programmes, it is necessary to focus on complementary health and nutrition inputs to accompany the school feeding, such as: nutrition and health education, micronutrient supplementation and deworming.
- ❑ Targeting: There is evidence that providing national coverage is not cost effective for national school feeding programmes. Targeting the most underserved, food insecure areas, with relatively low rates of school attendance (where the reason for lack of attendance is related to lack of income and not lack of a facility) seems to make the most sense. Regional coverage is often necessary to avoid children transferring to schools as a result of the school feeding. Within the selected regions, girls can be specifically targeted with take-home rations. Areas particularly hard hit by HIV/AIDS could also be targeted.
- ❑ Testing innovations: There should be room to design food-for-education programmes as true pilots, with the flexibility to test new methods of food delivery. USAID/Haiti, for example, has been experimenting with nutrient-rich snack biscuits made from surplus grains, which reduce the need for cooking and other preparations at the school and also provide micronutrients.

Source: USAID (2000) School Feeding/Food for Education Stakeholder's Meeting. October 3, 2000.

Disease type	Morbidity (no. of cases each year)	Mortality (deaths each year)
Diarrhoea	>4,000m	2.5m
Amoebic dysentery	48,000	70,000
Cholera	145,000	10,000
Roundworm	250m	60,000
Hookworm	151m	65,000
Whipworm	43.5m	10,000
Guinea worm	70,000	none
Trachoma	600m	none
Schistosomiasis	200,000	20,000

Table 1 Morbidity and mortality associated with various water and sanitation related diseases.

this meeting are found in the previous page.

Recent studies show the impact of what alleviating short term hunger can have on children's education:

□ a project in Indonesia that piloted the integration of deworming with a SNP found that combining these interventions has an even greater impact on growth than when food alone was provided. In India, school children participating in a SNP were also provided with treatment for geohelminths. This resulted in a reduction in helminth infection from 71% to 40% with minimal additional costs⁶²

□ an evaluation of a SNP in Jamaica examined the effects of the school meal on achievement, attendance and growth over a period of two semesters. It was found that the provision of breakfast resulted in higher school attendance and greater achievement in arithmetic although no weight gain was found⁶⁵

□ a second study in Jamaica examined the

⁶²The researchers noted that the students improved in the skills appropriate for their age level.

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effects in the short term on the cognitive function of children of differing nutritional status. It was found that cognitive function improved in undernourished children when they received breakfast while no difference was observed in well-nourished children⁶⁶

□ the same study also found that providing breakfast only benefited children's classroom behaviour if they attended well equipped and organised schools. The behaviour of children in poorly organised schools given breakfast deteriorated;

□ a recent study (case-control) in Mexico, evaluated the impact of a School Breakfast Programme. It examined the effects of school breakfast on the attention, memory and motor skills of 300 students, aged 4-6 years from impoverished areas. Children who received breakfast showed significant improvements in response, speed and fine motor skills when compared to the control group. Performance in verbal behaviour and short-term memory were not improved. The difference in these results as compared to other studies may be explained by the younger ages of the students in the study^{67, 68}; and

□ another recent study (case-control) evaluated the impact of a mid day meal (MDM) programme in 60 primary schools in India. It reported significantly higher enrollment, attendance, and retention rates with reduced drop-out rates among MDM programme children⁶⁸.

Health Problems

The poor, particularly children in low income countries, carry the greatest burden of morbidity and mortality. Much of this burden results from hazards within their homes or their immediate environment⁶⁹. High levels of malnutrition, and its known synergistic relationship exacerbate their vulnerability to disease particularly diarrhoeal disease, helminth infections, acute respiratory infections (ARIs) and malaria. For the urban poor in low income countries, there is a double jeopardy as they find themselves exposed to both "traditional" diseases of poor sanitation and overcrowding and the "modern" diseases of chronic heart

and lung disease. School-age children living in poor urban areas are also at a high risk of injury from road traffic accidents.

For children in low income countries, many of the health problems of childhood are associated with lack of clean water and poor sanitation (Table 1, previous page).

Diarrhoeal Diseases

Diarrhoea is the passage of loose or liquid stools, more frequently than is normal for the individual. It is primarily a symptom of intestinal infection, caused by a wide range of viral, bacterial and parasitic organisms. One of the most common means of infection is through water contaminated with human faeces. If severe or persistent, the fluid loss and dehydration associated with diarrhoea may be life threatening, especially in infants and young children, the malnourished, or people with impaired immunity.

WHO estimates that 3.3m children die from intestinal infections such as cholera, typhoid or infectious hepatitis every year. The total number of diarrhoeal episodes may be as high as 4000m (Table 1)¹⁰⁰. Most of the diarrhoeal disease burden occurs in children in developing countries, with under fives at greatest risk¹⁰¹. Approximately 90% of the diarrhoeal disease burden is related to environmental factors of poor sanitation and lack of access to clean water and safe food¹⁰².

A recent review of 144 different interventions demonstrated the impact on morbidity of general water, sanitation and hygiene interventions:

- 36% median reduction of diarrhoea from the safe disposal of faeces;
- 35% median reduction of diarrhoea from hand-washing with soap after contact with stools;
- 20% median reduction in diarrhoea from protection of water from faecal contamination; and
- 26% median reduction in diarrhoea from the integration of hygiene education or promotion in water projects¹⁰³.

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access to clean water, lack of adequate sanitation facilities and poor hygienic practices are high risk transmission factors for diarrhoeal diseases, there has been increased emphasis on hygiene promotion programmes as a means of changing behaviour and reducing the incidence of diarrhoeal diseases, as for instance:

- a study of hygiene related behaviour in families in rural Nicaragua found a consistent relationship between almost all hygiene practices (hand washing, food handling hygiene, disposal of faeces, etc.) and incidence of diarrhoea, with an association between number of years of schooling and better hygiene behaviour¹⁰⁴
- in Burkina Faso, a study looked at a three-year programme of hygiene promotion behaviour, targeted at mothers of young children. The study found that mothers who had been in contact with the programme showed a significant increase in behaviours such as hand washing with soap after cleaning a child's bottom or using the latrine. The authors concluded that hygiene promotion programmes can change behaviour, and are more likely to be effective if sustained over time, using locally appropriate channels of communication¹⁰⁵; and
- a further approach to diarrhoea prevention has been examined in Pakistan. Flies are known to be a potential source of spreading diarrhoeal diseases, through contact with faeces and food. Although fly control has previously been classified as an ineffective prevention measure by WHO, this study found that villages treated with insecticide during the 'fly season' had an incidence of diarrhoea that was 23% lower than untreated villages. Although long term routine spraying is inappropriate (expense and risk of insecticide resistance), as a short term measure, selective fly control during the 'fly season' might be useful in some circumstances¹⁰⁶.

DIARRHOEA PREVENTION: Since inadequate

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SCHOOL SANITATION AND HYGIENE: Hygiene promotion in schools is a primary intervention because of the potential high risk of disease transmission if facilities are either non-existent, in a poor state of repair or incorrectly used. In addition, studies show that school-age children can provide effective links with their peers (child to child) and the wider community in communicating important hygiene messages as well as promoting improved sanitation. Encouraging safer behaviour through participatory hygiene promotion has been shown to be more effective than traditional didactic measures, especially when linked with parallel efforts promoting hygienic behaviour, safe water and sanitation projects within in the community¹⁰⁷.

In many schools, facilities are either poor or absent. The aim of any school sanitation, hygiene and water programme is to combine hardware and 'software'. The former revolves around the construction of facilities and their subsequent maintenance and use, while the latter focuses on necessary and appropriate learning experiences to encourage safe practice at school, home and throughout later life. As well as assisting with the construction, maintenance and cleaning of facilities in the school environment, studies reveal that promoting latrine construction through school children can be a successful medium for promoting construction in the wider community¹⁰².

Hygiene promotion is now seen as an intrinsic element of any water and sanitation initiative and, in the context of school health, is now a central focus for school sanitation and hygiene programme¹⁰⁷.

This approach has the following key elements:

- the safe, efficient and hygienic disposal of faeces, particularly child faeces;
- the safe, efficient and hygienic management of water from extraction, through transport and storage to use (particularly for drinking and hand-washing); and
- the regular and effective use of

water (with a scouring agent like soap or ash) for hand-washing after contact with stools¹⁰⁸.

These three are generally considered to be the most important behavioural domains because they carry the greatest potential risk both on a personal and a communal level. There is increasing recognition of the importance of promoting safe hygiene behaviour among school children not simply because of its importance in the immediate school environment but also because of the communication opportunities and potential influence on the family and future families¹⁰².

In addition to the obvious health benefits and timesavings (particularly affecting young school-age girls), such programmes can also have an influence on school enrollment and attendance. The lack of adequate, separate sanitary facilities in schools is one of the main factors preventing girls from attending school, particularly when menstruating. For instance:

- in Bangladesh, a school sanitation programme increased girls' enrollment by 11%, a level that is beyond the reach of conventional educational reform¹⁰⁹.

Helminth Infections

Parasitic helminth infections are a major public health problem throughout the world with over a quarter of the world's population infected with one or more of the most common of these parasites: roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*) and hookworm (*Necator americanus* and *Ancylostoma duodenale*); and the schistosomes: *Schistosoma haematobium* (urinary) and *S. mansoni* and *S. japonicum* (intestinal)^{110,111,112}. Infection with intestinal worms is by a simple faecal-oral route. Infection with schistosomes is through contact with contaminated water (e.g. wading, bathing or swimming in ponds, rivers or lakes) that also contains fresh water snails that act as intermediate hosts.

Prevalence of these infections rises to a maximum in childhood and settles to a stable asymptote in the adult population. However, for the age-intensity (or worm burden) profile, there is a marked convexity,

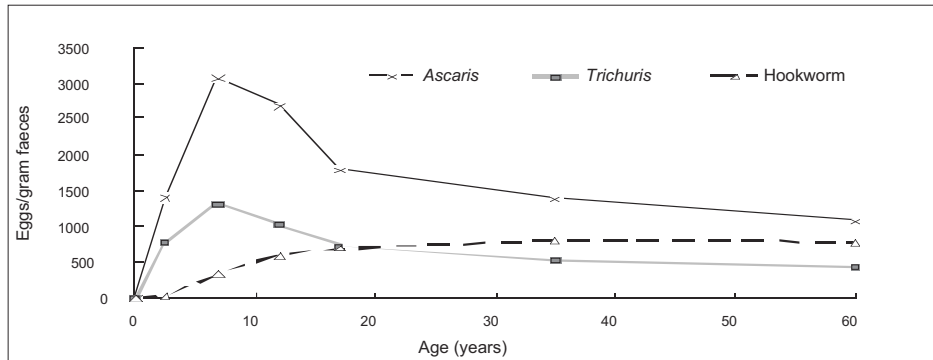


Figure 3 Intensity of geohelminth infection, by age. Source: adapted from Bundy et al. 1992

such that it is the school-age child who has the most intense infections (the greatest worm burden). As morbidity is directly related to the intensity of infection, it follows that it is this age group which is particularly susceptible (Figure 3)¹¹³. A similar picture is seen for *Schistosoma* age-infection patterns.

HELMINTH INFECTIONS IN THE SCHOOL-AGE CHILD: It is estimated that over 35% (320m) of school-age children are infected with roundworm; 25% (233m) with whipworm and 26% (239m) with hookworm^{114,115,112}. As the intensity of infection is the central determinant of the severity of morbidity, it is the school-age child who is most at risk; for girls and boys aged 5-14 years in low income countries, intestinal worms alone account for an estimated 12 and 11% respectively of the total disease burden of this age group, making this the single largest contributor to the disease burden of this group¹¹⁰.

As numbers of worms build up over time, many of the health problems caused by these worms are chronic and can be long lasting. In addition polyparasitism is a common occurrence; children may be infected concurrently with several parasite species¹¹⁶. Children with chronic worm infections and large numbers of worms may be stunted and underweight, which can lead to long term retardation of mental and physical development, even death in severe cases. Worms can also contribute to malnutrition

through inappetance and malabsorption and anaemia through loss of blood.

The most significant infection causing blood loss is hookworm infection. This may be caused by blood loss at the site of feeding; exacerbation of bleeding by the secretion of an anticoagulant; interference of uptake of iron in the duodenum; impaired appetite (with moderate to heavy infections). For example:

- data show a relationship between infection intensity and haemoglobin levels: as infection intensity increases (as indicated by an increase in egg output, i.e. eggs/gram of faeces), haemoglobin levels decrease^{28,117,118}
- a study of school children in East Africa suggests that the degree of IDA caused by hookworm infection depends not only on the intensity and duration of infection and iron stores of those infected but also on the species of hookworm. *Ancylostoma duodenale* was found to be more important in the prevalence of IDA than *Necator americanus*¹¹⁹.

The school-age child, but also pregnant women and preschool children, are most at risk from hookworm-attributable anaemia. Attributable fraction analyses indicate:

- for the preschool children: the anaemia of 14% of infected children and 28% of heavily infected children was attributable to hookworm infection²⁸

- among school-age children, the proportion of anaemia attributable to hookworm infection in all cases of iron deficiency anaemia in school-age children was 41% increasing to 57% for moderate to severe anaemia¹²⁰; and
- a study estimating the percent of cases attributable to hookworm infection in pregnant women estimated that 29% of all anaemia and 41% of moderate to severe anaemia was caused by hookworm infection¹²¹.

Whipworms can cause a degree of blood loss as a result of dysentery and mucosal damage, although it is likely that this is only of significance in severe infections. An association has been shown between anaemia and the roundworm, although how this is facilitated is unclear – possibly through malabsorption or inappetance.

Schistosoma infections can also lead to blood loss. *S. haematobium* eggs reach the external environment by being pushed from capillary vessels surrounding the bladder through into the bladder lumen, being subsequently released with host urine (*S. mansoni* eggs via the intestine). This activity leads to tissue damage and blood loss.

However, there has been uncertainty about the effect of *S. haematobium* on anaemia. Studies have shown that infection with *S. haematobium* can cause blood loss although it has not been clear whether, at a population level, this causes reduced haemoglobin concentrations. Multiple infections (polyparasitism) in school-age children make the study of this relationship particularly difficult. For instance:

- a recent study conducted in urban and rural areas of Tanzania compared the importance of *S. haematobium* and hookworm infections as a cause of anaemia in school-age children (7-12 years). The majority of children were infected with helminths, suffered from anaemia, were infected with malaria and were malnourished. The study found that although infection with *S. haematobium* per se was not significantly

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associated with anaemia in children with heavy infections, approximately one third of anaemia could be attributed to the parasite¹²².

Many studies have focused on the comparison of the prevalence and intensity of schistosomiasis between enrolled and non-enrolled children:

- a study in Egypt found that the prevalence of infections with *S. haematobium* and *S. mansoni* were higher in non-enrolled school-age children¹²³
- a study in Nigeria showed that although more out-of-school children were infected than those in school, the difference was not statistically significant¹²⁴
- a study in Zanzibar showed that non-enrolled children had a higher proportion of heavy intensity infections which were twice that of enrolled school-age children¹²⁵
- in Ghana, it was shown that adolescent non-enrolled boys were more heavily infected with *S. haematobium* than their school-going counterparts²¹; and
- a different study in Tanzania, however, did not find any difference in the prevalence of parasitic infections between enrolled and non-enrolled school children, but non-enrolled children were more stunted, wasted and anaemic¹²⁶.

These studies suggest the hypothesis that non-enrolled children may have worse health than children in school may be true for some indicators of health status, but that consistently finding worse health cannot be expected. More comparative research is needed.

IMPACT OF HELMINTH INFECTIONS ON EDUCATION: Establishing the linkages between helminth infection and cognitive development in school-age children is complex. Several studies have shown that children with moderate to heavy parasitic

Drug Treatment for Helminth Infections

The WHO recommends mass treatment of children in schools where the prevalence of infections is 50% or greater. Reinfection often occurs after 4-6 months, suggesting that school children need to be regularly treated in highly endemic areas. In areas where hookworm infections are endemic (prevalence >20-30%) and where anaemia is prevalent, WHO also recommends hookworm control strategies to improve the health and nutritional status of girls and women.

Dosage: 1 dose of 400 mg albendazole
 1 dose of praziquantel at 40mg/kg body weight

A recent assessment of the use of praziquantel and albendazole/mebendazole for women of child bearing age, and for pregnant and lactating women, concluded that these drugs may be used for such women, and that these women should not be excluded from treatment programmes.

helminth infections are associated with lower test scores of cognitive function and of educational achievement. However, convincing evidence of a causal link between helminth infection and cognitive function is yet to emerge:

- in a recent cross-study of school children that controlled for biological, socioeconomic and educational factors, helminth infection was associated with cognitive impairment. Children with heavy *S. haematobium* infections had significantly lower scores than uninfected children on short term memory and reaction time tests¹²⁷
- a detailed review of the major studies into the effects of helminth infection on cognition concluded that although the majority of studies have demonstrated an association, many of these studies are not able to conclude whether cognitive impairment is actually caused by infection or simply co-occurs with it¹²⁸
- a review of randomised treatment trials concluded that there was no evidence of improvement in cognitive function following deworming¹²⁹
- however, treatment does appear to improve cognitive development in children who suffer from the heaviest parasitic loads and who are undernourished^{130,131}; and

- a more recent helminth treatment study in Tanzania, implemented new cognitive measures of learning ability rather than measuring developed cognitive skills. The study showed that treatment did not result in immediate improvement. However when children were both treated and taught how to do the tests, their performance improved significantly more than children who were taught but not treated¹³². These results suggest that removing the causes do not necessarily remove the symptoms; in addition to treatment, affected children may require remedial stimulation to catch up¹³³.

CONTROL OF HELMINTH INFECTIONS:

Improved sanitation and hygiene provides the long term solution to controlling helminth infection. However, evidence showing the negative impact of helminth infections and the recent development of inexpensive drugs has led to an increase in mass control programmes^{134,135}. However, helminth infections are not necessarily evenly distributed. A recent analysis of prevalence surveys in Africa has found that the distribution of schistosome infection is largely independent of the distribution of geohelminths. This highlights the need for a cautious approach to combined control in areas where one infection is much lower in prevalence than another¹³⁶.

The expected beneficial effects of deworming include improved growth, appetite, fitness, cognitive performance and iron stores. Recent information also suggests that

deworming can contribute to the reduction of VAD. The precise mechanisms by which these improvements occur, however, are unclear^{137r}.

Treating helminth infections may have become more critical with recent evidence suggesting that the chronic immune activation caused by helminth infections makes the host more susceptible to HIV infection and enable the virus to replicate more rapidly^{138,139}. Evidence also suggests that chronic helminth infections may account for the higher prevalence of tuberculosis in low income countries and may compromise the development of protective immunity upon vaccination^{138,139}. However, this is an area of controversy and is currently under debate¹⁴⁰.

Deworming may also improve school attendance:

- in a recent study of the effect of treating helminth infection on school attendance, within six months there were significant improvements in attendance that continued for the study duration of 2 years. Due to the impact of mass treatment on the transmission of untreated children (attending treatment schools) had improved attendance as well¹⁴¹.

Recent studies of the effect of de-worming on growth have, as with previous studies, reported varied impact. Research suggests helminth infection suppresses children's appetites and that treatment results in weight gains. However, improved height gains have not consistently occurred in treatment trials. The intensity of infection, the regularity and duration of treatment and nutritional status have all been identified as important factors that influence programme impact. Overall the growth and nutritional deficits caused by these infections have been

^rA study into the effect of helminth infection on the resting energy expenditure of school-age children in Gambia concluded that the deleterious effect of helminth infection on growth is most likely to be due to a decrease in food intake and in intestinal absorption than to an increase in energy expenditure (Stettler et al., 1998)

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shown to be reversible through appropriate treatment:

- in Guatemala, school children who were given two treatments for very high levels of *Ascaris* infection (91%) were found to have modest increases in weight gain 6 months after the initial treatment¹⁴²
- a more recent evaluation study from East Africa into the effect of a school-based de-worming programme on growth after one year found that linear growth improved in children who received twice or thrice yearly treatment. Children who were less stunted and who were younger (less than ten years) benefited the most¹⁴³
- in Venezuela, a study of the effect of monthly anthelmintic treatment on school children resulted in a significant decrease in the proportion of children who were at or below the 10th percentile for height/age and an increase in the proportion above the 50th percentile after one year. At follow-up, eight months after the treatment, 55% were re-infected with *Ascaris*. Those with the highest rate of re-infection were found to be stunted or underweight children¹⁴⁴
- in a randomised, double-blinded control trial in Brazil of 353 school children, those with mild to moderate *S. mansoni* infections were randomly allocated to treatment or placebo group. One year later, treated boys had significantly higher measurements of weight, triceps skinfold thickness, midarm circumference, arm muscle area, and body mass index than untreated boys. These results indicate that, at least in boys, chronic *S. mansoni* infection even at low intensity is detrimental to short term growth and development¹⁴⁵
- a study from Indonesia that looked at the effect of treating *Ascaris* in school children did not find any beneficial effect on growth five months after treatment¹⁴⁶

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- in a study that examined the effect of treatment for helminth infections on growth, appetite and physical activity in 149 Indonesian schoolboys, the treatment group was given a single dose of albendazole, measurements were taken at baseline and six months after treatment. Results indicate that treatment for helminth infection may increase growth, appetite and activity level six months after treatment in areas where malnutrition and helminth infections are endemic. De-worming treatment is recommended every four to six months in endemic areas, thus improved growth six months after treatment is an important indicator of impact¹⁴⁷
- a recent study comparing the impact of twice-yearly and thrice-yearly de-worming with no de-worming on the iron status of school-age children found that the incidence of moderate and severe anaemia was significantly reduced in the twice-yearly group by 23% and in the thrice-yearly group by 55%. The programme impact, conferred the greatest benefit to those at the greatest risk from severe IDA^{148,s}
- A case control study of school-age children in Tanzania found that a combined single dose treatment for schistosomiasis and *Ascaris* resulted in a significantly reduced intensity of infection in almost half the treatment group. The greatest impact of the combined treatment was on children who were anaemic and heavily infected with hookworm¹¹⁸
- in Tanzania, cross sectional studies involving anaemia evaluation and parasitological examination were implemented before and at 10 and 15 months following deworming of school

children. The baseline study reported a high level of anaemia, 54%; attributable fraction analysis suggested that hookworm and schistosomiasis were responsible for 6% and 15% of anaemia cases, respectively. Fifteen months after de-worming (with albendazole and praziquantel), the prevalence of anaemia was reduced by a quarter and moderate to severe anaemia was reduced by nearly a half. Analyses from these findings, suggest that school-based deworming programs can prevent anaemia at a cost per case prevented over 15 months of between US\$6-8¹⁴⁹

- a study of school children in China and the Philippines treated for geohelminths and schistosomiasis found a significant increase in haemoglobin levels in those who received a single dose of praziquantel¹⁵⁰; and
- Beasley's study conducted in urban and rural areas Tanzania found that although infection with *S. haematobium* per se was not significantly associated with anaemia in children with heavy infections approximately one third of anaemia could be attributed to the parasite. These results lend weight to the argument of integrating control activities for schistosomiasis and helminths¹²².

Recent research shows that school based deworming programmes can reach out to those not enrolled in school and be effective:

- a study in Zanzibar showed that when a good communication network is established between teachers, parents, siblings and friends of school-age children that all children (irrespective of enrollment status) can easily, successfully and inexpensively be included in school based deworming campaigns¹²⁵
- in countries where schistosomiasis is endemic, such as in Egypt, it has been shown that interventions in schools may not only improve the health of school attendees, but also can be an affordable way of extending services to out of school children¹⁵¹; and

^sNote that a reason given for the failure to reduce mild-moderate anaemia is that deworming alone does not increase the body's storage of iron but protects against severe iron loss. It is also argued that there is a trade off between growth and iron in that growth requires iron and if growth is occurring then iron stores will remain low.

- further research tested an intervention to extend routinely applied school-based treatment to out of school children and showed that out of school children can be reached at a relatively low cost¹⁵².

Malaria

Malaria is probably the world's most important parasitic infectious disease, occurring in tropical and sub-tropical countries. It is caused by four species of *Plasmodium* parasite; *P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*. Several species of *Anopheles* mosquito can act as the definitive host, and it is transmitted via the bite of infected female mosquitoes, which breed in fresh (or occasionally brackish) water. The symptoms of malaria include fever, chills, headache, nausea, muscle aches, tiredness, vomiting, diarrhoea, anaemia and jaundice. In severe cases, it can also cause convulsions, coma, severe anaemia and kidney failure.

Globally the malaria situation is serious and worsening with mortality ranging between 1.5-2.7m and morbidity 300-500m annually. Although malaria affects 40% of the world's population, 90% of the burden is in Africa (south of the Sahara).

MALARIA IN SCHOOL-AGE CHILDREN: Most studies to date have focused primarily upon pre-school children estimating that over 75% of all-age malaria mortality is experienced by this age group¹⁵³. In contrast there are few empirical studies on mortality in school-aged children. However, recent preliminary estimates suggest mortality among school-aged children is between 5-14% lower than among younger children. This implies that malaria may still account for 10-20% of all-cause deaths among school-age children¹⁰¹.

School children who have not acquired exposure-driven immunity may be at particularly high risk of severe and fatal consequences when exposed to the disease in unstable transmission areas. However, these risks are balanced by the low, and often very seasonal, exposure to the parasite. Pregnant schoolgirls are also a particular high-risk group¹⁵⁴.

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Malaria is also an important cause of morbidity, but again, data is lacking, although recent data suggests that the risk of morbidity declines rapidly with age. Children aged 5-9 years experience between 0.25-2.3 malaria attacks per annum and children aged 10-20 years experience between 0.1-1.3 attacks per annum¹⁵⁴.

Malaria can cause iron deficiency and anaemia. However, the effect of malaria on iron metabolism and anaemia is not fully understood, particularly in endemic areas where large numbers of school-age children are affected but are asymptomatic:

- in a recent cross sectional study from Nigeria, 228 school-age children were evaluated to determine the effect of low-level plasmodial infections on anaemia. The prevalence of anaemia increased when higher numbers of *Plasmodium* species were detected; and the prevalence of anaemia increased with the complexity and extent of *Plasmodium* species¹⁵⁵. These results suggest that low-level plasmodial infections also contribute to anaemia.

IMPACT OF MALARIA ON CHILDREN'S EDUCATION: Malaria accounts for between less than 3% and 8% of all reasons of absenteeism (0.001-0.021 days p.a.)^{156,157,158}. However, of preventable medical causes of absenteeism malaria counts for a significant 13-50% of school days missed per annum. Under the assumption that each malaria attack contributes two to five days absence from school,^{159,157} it is estimated that malaria is responsible for 4-10m school days lost (1% of all days lost in Kenya per annum)¹⁵⁴.

The evidence also suggests that brain insult, as a consequence of cerebral malaria, in early childhood may have an effect on a child's cognitive and learning ability; residual neurological sequelae of 1-5% of children infected early in life¹⁵³.

IMPACT OF CONTROL ON MALARIA: The priority age group for malaria control is younger than school-age children¹⁵⁴. However, WHO and the World Bank are working with the Roll Back Malaria Partnership to identify an effective,

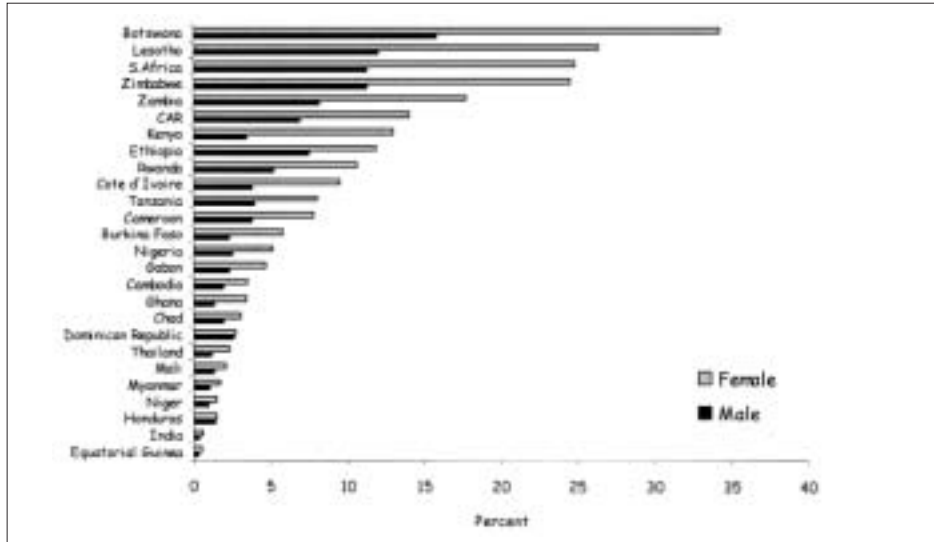


Figure 4 HIV/AIDS prevalence rates for young people, aged 15-24, by gender, selected countries, end of 1999. Source: UNAIDS 2000a in World Bank 2002. Prevalence rates are given as midpoint between the UNAIDS' low and high estimates for each country.

operational response to the issue of malaria control in school-age children.

Some interventions may be inappropriate for the school child:

- a study from Kenya where the provision through schools of chemoprophylaxis, mass drug administration, selective treatment of infections and fever management with diagnostics were considered unaffordable options^{154,160}.

However, school-based malaria prevention programmes are a good example of how schools can make a contribution to community health. It is suggested that children can be important agents for change in malaria control programmes. The promotion, by schools, of prompt and effective presumptive treatment provides an affordable control option. Skills based health education can give children the ability to recognize the signs and symptoms of malaria, to recognize the need to seek treatment, and to differentiate symptomatic from curative treatment.

Skills based health education through

schools can also help promote a community wide understanding of malaria with particular emphasis on the need for community based control measures such as the use of impregnated bed nets. Schools can serve as a focus for synchronised impregnation of bed nets and distribution¹⁶¹.

Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS) and School-Age Children

Approximately 40m people throughout the world are now living with HIV/AIDS (with 70% of these people living in sub-Saharan Africa), including almost 3m children under the age of 15. The impact and repercussions of this global epidemic in every sphere of people's lives is now becoming apparent¹⁶².

HIV is a retrovirus that attacks and weakens the immune system. Although an infected person may look and feel well for many years, as their immune system weakens they become unable to fight infection and become more vulnerable to a range of serious diseases, such as tuberculosis, pneumonia and cancer, and to opportunistic infections (such as fungal infections) that would not normally affect people with healthy immune

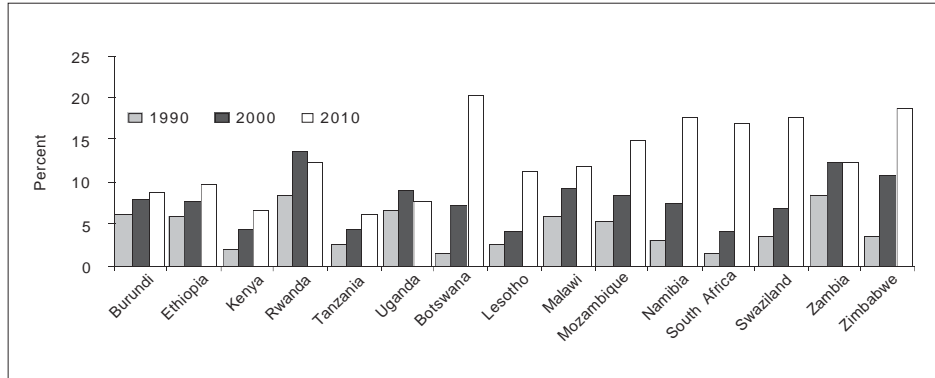


Figure 5 Estimated number of AIDS orphans (maternal and double) as a percent of all children under 15 years old. Source: Hunter & Williamson, 2000 in World Bank 2002.

systems. AIDS is the term used for the group of health problems, such as weight loss, various infections, tumours and other health problems associated with HIV infection.

HIV is contracted and spread through sexual contact (unprotected vaginal or anal sex); direct inoculation of infected blood (e.g. through contaminated needles) and from an HIV positive mother to her child (at birth or through infected breast milk).

PREVALENCE IN SCHOOL-AGE CHILDREN: Throughout the world, HIV infection prevalence is lowest in the 5 to 14 year old age group, and AIDS mortality does not have its primary effect on school-age children. The majority of children dying of AIDS are young children who have contracted the disease from mother-child transmission. An estimated 3.8m children have been infected with HIV since the epidemic began, and more than two-thirds have died. UNAIDS estimates that in 2001, 800,000 children under the age of 15 became newly infected with HIV, and that 580,000 children under the age of 15 died of AIDS, the vast majority of them in Sub-Saharan Africa¹⁶³. During this time, approximately 2.4m adults (aged 15 to 49) died of AIDS.

Girls and young women are highly vulnerable to contracting HIV/AIDS for social, cultural, economic, and even physiological reasons (Figure 4 previous page). A lack of education increases this

vulnerability, due to inequalities in status, power, and access to resources. Many girls and young women find that they have little choice and control over decisions about sex, and may be exposed to unprotected sex, often with older men. This may be in exchange for gifts, money or favours, or as a result of abuse, including by teachers^{163,164}.

DIRECT AND INDIRECT EFFECTS OF HIV/AIDS:

Orphans and Other Vulnerable Children The relatively low prevalence of HIV/AIDS in school-age children means that the direct effects of AIDS related illness in this age group constitute a relatively small proportion of the total burden of disease. In contrast, the indirect effects are enormous. Children may suffer both physically, socially and psychologically through death or illness of members of their family - including parents. In countries with the highest prevalence of HIV/AIDS, the concentration of AIDS in the working age adult population means that there are fewer adults to care for the increasing population of orphans and vulnerable children. This situation includes countries such as Botswana - where one in three adults are infected, Zimbabwe - where it is one in four, and countries such as Zambia and South Africa - where 20% of adults are infected.

One of the greatest impacts of the AIDS epidemic is on the children orphaned by AIDS. Before AIDS, an estimated 2% of

children in Africa were orphans. Today, the proportion has risen to almost 15% of children in some African countries (Figure 5). It is estimated that 50% of these children were orphaned by AIDS. Over 13m children under the age of 15 have lost their mother or both parents to AIDS, most of them in sub-Saharan Africa. In less than 10 years time, the figure is expected to reach more than 25m^{162,164}.

Orphans are amongst the most vulnerable people in society. They suffer the trauma of seeing one or both parents becoming ill and dying from AIDS. Many will have to change home several times as they move to live with other family members or relatives, who may themselves become ill and die. They also run a greater risk of becoming stunted and malnourished and may miss out on schooling, due to lack of funds. For example:

- a study in Cote d'Ivoire found that when a family member had AIDS, food consumption dropped by 41% as family income in turn fell by 52% - 67%, and expenditure on health care, for AIDS-related illness, quadrupled^{165,166,164}.

HIV/AIDS does not affect only households with children orphaned by AIDS; it also affects the children living with HIV-positive parents or relatives. This group of children serves as an indicator for the future orphan burden. The exact number is unknown and most countries have no estimates. Like the children who have lost their mothers or both parents, this group of children may be discriminated against, may lack basic health care and education, may experience physical and psychosocial stress, and may have little or no social and economic support. The children are frequently young; the mean age of orphaning is only 6.2 years¹⁶⁷. They are also often forced to take on responsibilities far beyond their years, not only caring for other siblings but also for their parents - the people who they look to for love and support. An adult who has AIDS requires increasing help with everyday activities (which is expected from the child), but also suffers from frequent opportunistic infections such as uncontrollable episodes of diarrhoea, in conjunction with the slow

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debilitating effects of the HIV itself. The responsibility for caring for them frequently falls entirely on their young children. The psychological demands and effects on the child must not be underestimated¹⁶⁸.

STRATEGIES TO PROTECT AND ASSIST CHILDREN: Children on the Brink 2002, outlines five key strategies for supporting orphans and other children affected by HIV/AIDS:

1. strengthen and support the capacity of families to protect and care for their children;
2. mobilize and strengthen community-based responses;
3. strengthen the capacity of children and young people to meet their own needs;
4. ensure that governments develop appropriate policies, including legal and programmatic frameworks, as well as essential services for most vulnerable children; and
5. raise awareness within societies to create an environment that enables support for children affected by HIV/AIDS¹⁶².

For school-age children, especially vulnerable children, finding strategies to keep them in school, or to reach them in out of school situations, is one of the key lines in defence against HIV/AIDS, especially for girls. By remaining in education, girls may have the opportunity to reduce the social and economic vulnerability that exposes them to the higher risk of contracting HIV.

HELPING ORPHANS AND OTHER VULNERABLE CHILDREN TO STAY IN SCHOOL: Initiatives to increase the capacity of communities to support orphans and other vulnerable children have been adopted in a number of countries. Governments and NGOs work with the local community in a number of ways to support orphans and other vulnerable children, such as: offering community-based child care, allowing children caring for other siblings to attend school; persuading schools to accept more orphans; persuading guardians to send children to school; assisting vulnerable household with tasks such as tending crops or collecting firewood. In Zimbabwe the

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government supports a Community Based Orphan Care Project, that uses community volunteers organised by local village committees. The volunteers help ensure that orphans are well fed, housed and clothed, and if possible attend and remain in school. Other countries to adopt this approach include Zambia, Malawi, Uganda and Kenya.

The major obstacles currently limiting orphans and other vulnerable children's access to education are: lack of finances; increased family responsibilities; discrimination, stigma and trauma; scepticism about the value of primary education and poor educational quality¹⁶⁹. A number of initiatives and proposals have been explored in Africa to try to overcome these obstacles¹⁷⁰:

- subsidy of prohibitive school-related expenses for individual children: In many cases school-related expenses, including textbooks, uniforms and PTA fees are more prohibitive than actual primary school enrollment fees. In some countries programmes have been initiated by local and international NGOs to help subsidise individual children or groups of children, often by linking them with sponsors or a sponsorship organization. Countries including Zambia, Zimbabwe, Malawi and South Africa currently have ...the 'Memory Project'...aims to help such schemes, HIV positive mothers prepare their children for the time when they will no longer be there... helping to increase access to school for some of the most vulnerable children, who are currently excluded for financial reasons. Community support and involvement is critical for identifying the most vulnerable children and families in need of assistance;
- community schools: Community schools are run by the local community or churches. They do not charge fees and children are not required to wear uniforms. Local teachers are used, often on a voluntary basis. Such schools provide a more flexible approach to education, as timetables, days and terms

of activity can be adjusted to local needs. Such schools are becoming increasingly popular in areas affected by AIDS, and have been adopted in a number of countries including Zambia, Uganda, Malawi, Mali and others; and

- distance learning and interactive radio education: Distance learning using media such as radio, is an increasing option for attempting to reach out-of-school children and youth. In Zambia a pilot project is under way in several Districts, using a radio-based learning system to reach students who do not attend formal schools. The pilot programme provides lessons in mathematics and English language, with students meeting for a limited number of hours each day in community centres. Trained, literate community mentors are matched with students to provide instructional support. Initial evaluation of the pilot programme has found it to be effective and popular¹⁷¹.

Any strategies to assist children in gaining access to education should not be directed only to children orphaned 'biologically' by AIDS. They should be directed to all vulnerable children, who include children infected and affected by HIV/AIDS, street children, children exposed to strenuous labour, children with disabilities, children engaged in trafficking, and children affected by armed conflict. These children are sometimes more vulnerable than the orphans¹⁶².

Psychological and Emotional Distress Besides the problems of adequate food, health care and education, an area that is too frequently neglected is the emotional distress of children living with a parent who is terminally ill, or who have lost one or both parents. One approach shows:

- a group that has sought to address this issue is the National Community of Women Living with AIDS (NACWOLA), in Uganda. They have started the

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'Memory Project', which aims to help HIV positive mothers prepare their children for the time when they will no longer be there to give them parental love, guidance and support. Central to the project is the 'memory book', prepared jointly by the mother and child, containing mementos, written pieces and pictures of family members and family life, together with advice to the children on how to live and take care of each other^{172,168}.

SCHOOL-BASED PREVENTION PROGRAMMES: Schools are the main institutions able to reach a large number of children and young people, with the support and involvement of the local community. Schools have the opportunity to reach children before they become sexually active, and while they are open to adopting healthy ways of behaving and protecting themselves from infection. Schools can serve as the forum where adolescents can obtain accurate information on reproductive health and HIV/AIDS, together with the skills and support needed to help them protect themselves from infection.

However, at present there is still little hard evidence that school HIV/AIDS prevention programmes that fail to adopt the skills-based approach have a major impact on sexual behaviour:

- a recent survey carried out in Botswana, Uganda and Malawi found that although the students in the survey schools were generally well informed about the causes and consequences of HIV/AIDS, this did not translate into major changes in behaviour. The researchers concluded that the economic, social and cultural pressures that led to unsafe sex amongst adolescents remained as high as ever. They found that teachers often received little or no training in HIV/AIDS education and lacked the confidence, competence and commitment to teach these topics¹⁷³.

Before teachers can expect to implement skills-based health education in schools, many will need to justify their intent and

convince administrators, teachers, parents and members of their community that HIV prevention through schools is appropriate and essential to the welfare of their children, their families and their nations. Furthermore, before teachers can expect to help students acquire the skills needed to prevent HIV infection, teachers themselves will need to acquire skills to use participatory learning activities to enable their students to acquire prevention skills¹⁷⁴. This is now regarded as a priority action by many governments and agencies including WHO¹⁷⁵, UNESCO, UNICEF and the World Bank.

In many countries, school-based reproductive health and HIV/AIDS education is often used as part of a wider strategy of community and national HIV/AIDS prevention programmes, and may be most effective in this context, especially when a skills-based approach is utilized.

SKILLS-BASED HEALTH EDUCATION: Skills-based health education, including HIV/AIDS prevention, aims to help children develop the knowledge, attitudes, values, and skills- including interpersonal skills, critical and creative thinking, decision-making, and self awareness -needed to make sound health-related and social decisions.

According to major reviews covering 23 studies in the United States¹⁷⁴; 53 studies in Europe, the United States, and elsewhere¹⁷⁵; and 37 studies in other countries, including in Asia and Latin America¹⁷⁶:

- school-based HIV/AIDS prevention adopting a life skills approach to health education is effective:
- behaviour change is possible if programmes focus on specific

¹⁷⁴Education International, WHO and Education Development Center have developed a School Health/HIV Prevention Training and Resource Manual to enable teachers to advocate for effective education about HIV and to use participatory learning experiences to help students acquire prevention skills. Nationwide teacher training projects have now been implemented by teachers unions, in collaboration with their ministries of health and education, in 17 countries, 15 of which are in Africa. Since starting operation in 2001, this effort has provided training to over 50 000 teachers and its skills-based training/learning activities have been integrated into the HIV training programmes and material resources of many ministries of health and education. (WHO, 2004).

¹⁷⁵addition to original text. Source WHO (2004).

behavioural goals, provide sufficient training and support for teachers, and use an age-appropriate and gender-sensitive design; and

- programme impact occurs slowly and is significant, but not large. For example, AIDS prevention campaigns in Switzerland helped reduce the share of sexually active 17 year old boys from 65% in 1985 to 54% in 1997, while the share of sexually active 15 year old boys in the US fell from 33% in 1988 to 25% in 1995¹⁷⁷. Note, however, that for the worst affected countries and those with large populations, relatively small and slow changes in behaviour could save the lives of millions of children.

These studies are encouraging:

- a recent evaluation of an intensive, two-year, school-based health education programme in Uganda found that the share of students in their last year of primary school who reported being sexually active dropped from 42.9% in 1996 to 11.1% two years later. A control group exposed only to the national health education curriculum showed no significant decline during the same period¹⁷⁸; and
- effective life skills programs have also been shown to promote abstinence and help children and adolescents to delay first sex^{179,166,180,181}.

There is, however, still a lack of broad evidence on the success of the skills-based approach in Africa, and few cases of

large scale implementation of programmes, underscoring the need for greater monitoring and evaluation of the impact of interventions in the continent most gravely affected by the epidemic¹⁶⁴.

The UNAIDS Interagency Task Team (IATT) for HIV/AIDS is an initiative that seeks to share experiences among countries in sub-Saharan Africa with the intent to promote

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Education for All (EFA) and the Millennium Development Goals (MDG)¹⁸². In an attempt to document seeming good practice, the UNAIDS IATT have published a Sourcebook of school-based prevention programmes that summarizes 13 promising programmes from eight countries in sub-Saharan Africa. Programmes were evaluated (only in terms of content) against UNAIDS Content Evaluation Benchmarks.

Addressing the Issues

This synthesis shows that a child's ability to attain her or his potential is directly related to the synergistic effect of good health, good nutrition and appropriate education. The evidence presented in this paper, and elsewhere, demonstrates the positive impact that simple interventions to combat malnutrition and ill health in the school-age population can have on health, nutrition and learning.

Improving the health and learning of school children through school-based nutrition and health programmes is not a new concept. However, many early programmes have been characterized as being heavily focused on disease prevention, being uncoordinated, lacking integration and poorly evaluated and disseminated. Most importantly, the traditional school nutrition and health programmes have been based in the better off schools and in urban centres. This situation appears to be rapidly improving as new policies and partnerships are being formulated which help ensure that programmes are socially progressive and specifically target the poor, girls and the most disadvantaged children.

This change in perspective is timely as countries and agencies seek to achieve Education for All (EFA) by 2015, and address the Millennium Development Goals (MDG) of Universal Basic Education and Gender Equality in Education Access. If every girl and boy is to be able to complete a basic education of good quality, then school nutrition and health programmes are essential to ensure that the poorest children,

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who suffer the most malnutrition and ill health, are also able to attend school.

In order to operationalize an effective response, education sectors need to develop an infrastructure and policy context for improving the nutrition and health of school children. A major step forward was taken when a framework to Focus Resources on Effective School Health (FRESH) was developed by UNESCO, WHO, UNICEF, Education International and the World Bank and launched at the World Education Forum in Dakar in April 2000. Partners also include WFP, The Partnership for Child Development, and Save the Children US.

The FRESH framework provides the context for effective implementation of access to health and nutrition services within school health programmes. School based health and nutrition services, such as food for education, micronutrient supplementation and deworming, are most effective when they are supported by other strategies. These strategies include policies to provide a non-discriminatory safe and secure environment, provision of safe water and sanitation, effective referral to external health service providers and links with the community. The FRESH framework provides this context by positioning access to health and nutrition services among four core components that should be made available together for all schools:

- health related school policies;
- safe water and sanitation;
- skills based health and nutrition education; and
- access to health and nutrition services.

These core components of the FRESH framework require school-community partnerships as the supporting strategies for the success of school health and nutrition programmes. These include effective partnerships between the health and education sectors, teachers and health workers, schools and community groups and between the pupils and those responsible for implementing school health and nutrition programmes.

Focusing initially on these activities allows concerted action by the participating

agencies, and will ensure consistent advice to country programmes and projects. Because of the focused and collaborative nature of this approach, FRESH has increased the number of countries able to implement school health components of child-friendly reforms, and helped ensure that these programmes go to scale. The focused actions are seen as a starting point to which other interventions may be added as appropriate. The actions also contribute to existing agency initiatives. They are an essential component of the "health promoting schools" initiative of WHO and of the "child friendly" schools of UNICEF, as well as of many other global efforts to make schools effective, healthy, hygienic and safe.

The FRESH framework specifically addresses the need for nutrition and health services in schools. School-based nutrition and health services are effective and cost-efficient provided that the services are simple, safe and familiar, and address problems that are prevalent and recognised as important within the community. For example, improving meal timing or providing snacks can address student hunger during school, which seriously constrains learning and contributes to poor school performance. Similarly, semi-annual or annual oral treatments can be an effective means of addressing micronutrient deficiencies and worm infections. With treatment of worms, micronutrient supplementation is a cost-effective and simple method of reducing certain vitamin deficiencies in school-age children. School officials delivering simple health services in schools can easily correct these basic, yet pervasive, health deficiencies.

Technical documents have been produced by the agency partners in support of the FRESH framework, including:

- rationales for the four core FRESH activities;
- a School Health Toolkit for teachers and programme implementers; and
- FRESH and its role in the Achievement of Education for All.

These technical documents are based on the current experience of researchers, policy

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makers and school health programmers and represent the 'best practice' for school health and nutrition programming.

As a result of concerted action by the participating agencies, national programmes using the FRESH framework have now been adopted by over 20 countries in sub-Saharan Africa, ultimately benefiting a target population of 45m school age children.

These school nutrition and health programmes provide an infrastructure and a context for the education sector to deliver a wide range of specific interventions. Partnerships of agencies are currently working to support intervention in some key areas.

The 'Food for Education' initiative of WFP and partners is working globally to address some of the nutritional, health and educational problems of school-age children. The initiative aims to alleviate short term hunger, improve the quality of student's diets, deworm and motivate parents to enroll their children, especially girls, in school and encourage them to attend regularly.

So far 80 managers from a total of 21 countries and 30 technical personnel have been trained and formed a Regional technical resource Team. Deworming activities within WFP supported school-feeding programmes have started in seven countries and reach 520,000 children. Activities in 14 other countries are being planned.

The 54th World Health Assembly's resolution set a global target of scaling up intervention to regularly treat 75% of school-age children (398m) at risk by 2010. To achieve this goal, WHO has taken the lead in developing a broad partnership that promotes the incorporation of deworming of school-age children into existing institutions and programmes, for both the education and health sectors¹⁸³. The Partnership for Parasite Control (PPC) was launched in 2001, with

the aim of mobilizing resources and promoting new synergy among public and private efforts for the control of soil-transmitted helminths and schistosomiasis at the global and national levels. Working with the World Food Programme (WFP), the Canadian International Development Agency and the World Bank, WHO in 2001 trained representatives of the ministries of health and education of 21 countries, and deworming programmes have already begun in 19 of the 41 endemic countries in Africa.

WHO and the World Bank are working with the Roll Back Malaria partnership to identify an effective operational response to the issue of malaria in school-age children. Positive experiences by governments and civil society (especially Save the Children, US, and AMREF) in Senegal, Mali and Kenya are contributing to the creation of a toolkit of promising practices for malaria in schools.

An initiative of the HIV/AIDS affected countries and the UNAIDS IATT for HIV/AIDS and Education calls for a multi-partner effort from countries, development partners, civil society and the private sector to promote high level understanding and leadership, and the development of effective national responses across the education sector¹⁸⁴. The initiative seeks to share experiences among countries in sub-Saharan Africa, and has two main objectives. First, to promote EFA and the MDG, which will ensure that every girl and boy has access to quality education despite the impact of HIV/AIDS on the education system. Second, to strengthen the capacity of the education sector to respond with timely actions to prevent students and teachers from being infected with HIV. The initiative aims to support country actions throughout Africa, and was launched in Kenya in November 2002. As part of this activity, and as previously mentioned, a consortium of countries and agencies has summarized 13 promising programmes from eight countries in sub-Saharan Africa and published a "Sourcebook of School Based Prevention

Positive experience by government and civil society...are contributing to the creation of a toolkit of promising practices for malaria in schools.

Programmes".

Much remains to be done. But countries and agencies are now working actively to ensure that poor nutrition and ill health no longer hold children back from what may be their only opportunity to receive an education.

Acknowledgements

The authors would like to thank Alicia Fentiman for her contribution on non-enrolled children, Joy Del Rosso, Amaya Gillespie, Seung H. Frances Lee and Flora Sibanda-Mulder for helpful comments on earlier drafts of this document.

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