Consortium for Research on Educational Access, Transitions and Equity

Impact of Health on Education Access and Achievement: A Cross-National Review of the Research Evidence

Pat Pridmore

CREATE PATHWAYS TO ACCESS
Research Monograph No 2

June 2007

Institute of Education
University of London

Consortium for Research on
Educational Access, Transitions & Equity

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The Consortium for Educational Access, Transitions and Equity (CREATE) is a Research Programme Consortium supported by the UK Department for International Development (DFID). Its purpose is to undertake research designed to improve access to basic education in developing countries. It seeks to achieve this through generating new knowledge and encouraging its application through effective communication and dissemination to national and international development agencies, national governments, education and development professionals, non-government organisations and other interested stakeholders.

Access to basic education lies at the heart of development. Lack of educational access, and securely acquired knowledge and skill, is both a part of the definition of poverty, and a means for its diminution. Sustained access to meaningful learning that has value is critical to long term improvements in productivity, the reduction of inter-generational cycles of poverty, demographic transition, preventive health care, the empowerment of women, and reductions in inequality.

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List of Acronyms

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Treatment
CREATE	Consortium for Research on Educational Access, Transitions and Equity
DFID	Department for International Development
DQ	Developmental Quotient
EFA	Education for All
FFE	Food for Education
FRESH	Focus Resources on Effective School Health
HAZ	Height-for-age Z-score
HIV	Human Immunodeficiency Virus
IDA	Iron Deficiency Anaemia
IRC	International Water and Sanitation Centre
IQ	Intelligence Quotient
MRC	Medical Research Council
MDG	Millennium Development Goal
RCT	Randomised Controlled Trials
SCN	United Nations System Standing Committee on Nutrition (SCN)
SD	Standard Deviation
SSA	Sub-Saharan Africa
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

Preface

This research monograph is one of several in the CREATE Pathways to Access Series that address influences on improvements in access to education. Specifically it reviews the international research literature on the impact of health and nutrition on education access and achievement, with a particular focus on studies in low and middle income countries that relate to gender, poverty, social exclusion and innovative practices. The CREATE Zones of Access Model, described in Research Monograph No 1, is used as an organising framework for the review.

Pat Pridmore discusses findings, research designs and methods, theoretical models of health and nutrition that underpin research and identifies gaps in our knowledge. In broad terms she concludes that poor health and nutrition contribute to educational exclusion in Zones 1, 2 and 3, evidence that lends strong support to a wide range of school health and nutrition policies and programmes implemented in recent years. The final section outlines improved research designs and an agenda of for research in the future.

This is an important contribution to a growing debate about the need for interventions in sectors beyond education if education access and achievement are to increase. Pat Pridmore also suggests that the initial CREATE Zones of Access model be expanded to include the role played by health shocks from birth (or even conception) to the age of school enrolment in the process of education exclusion.

Professor Angela W Little
Institute of Education, London
CREATE Partner Institute Convenor

Summary

This literature review synthesises the findings from published reviews and key individual studies of health, nutrition and educational access with a particular emphasis on issues of gender, poverty, social exclusion and innovative practices. It discusses the advantages and disadvantages of the range of research designs and methods employed in these studies and the theoretical models of health and education that lie behind the studies and identifies knowledge gaps that could be filled by new empirical research. It also draws implications from the literature review for the further conceptual development of the CREATE Zones of Access model and for the design of future empirical studies paying special attention to school and community-based studies and identifying questions that could be included in household and school survey instruments.

Impact of Health on Education Access and Achievement: A Cross-National Review of the Research Evidence

1. Introduction

Access to food, health care and education is recognized as a basic human right. This right is enshrined in the Millennium Development Goals (MDG's) through which all member states of the United Nations have committed themselves to attaining universal primary education and eradicating hunger. Despite the high profile given to education within this international agenda to eradicate poverty, UNICEF (2006) reports that in the poorest countries as many as 29% of boys and 35% of girls are out of primary school and 70% of boys and 74% of girls are out of secondary school. These children are excluded and invisible.

Children's access to education and to learning is affected by the availability and quality of schooling and by family characteristics such as socio-economic status and parental attitudes to schooling. Access can also be influenced by child characteristics, such as aptitude, motivation and behaviour, which can be negatively affected by poor health and nutritional status. It is therefore of some concern that a quarter of all children eligible to be in school are malnourished (Galal et al., 2005) and that children in developing countries frequently carry an additional burden of infectious diseases.

It is estimated that 60 million school-age children suffer from iodine deficiency disorders, 85 million are at risk for acute respiratory disease and other infections because they are deficient in vitamin A, and 210 million suffer from iron deficiency anaemia (Jamieson et al., 1993). Parasitic worms (including hookworm, roundworm, whipworm, and schistosomiasis) are a major source of malnutrition with an estimated 880 million school-age children infected (Partnership for Child Development, 1997; Montresor et al., 1998). Malnourished children become even more malnourished when they are infected with worms, which interfere with nutrient uptake and are a major cause of anaemia.

Furthermore, over 38 million adults and children worldwide are living with HIV and 15 million children have already been orphaned by AIDS (UNAIDS, 2006). Millions more children live in families affected by HIV and are at risk of being both pushed and pulled out of education (Pridmore and Yates, 2005) .

Given the magnitude of the health and nutrition problems affecting children and the drive to reach the MDGs it is surprising that scarce attention is paid to the health and wellbeing of school children in education sector planning (Galal et al., 2005). One exception is HIV prevention education (and increasingly deworming), which is a recognized international agenda with a high research focus. Policy makers and planners need to know more about the effect that malnutrition and infection can have on children's access to education, scholastic performance, age of enrollment, concentration in class, attendance and achievement in different socio-economic contexts, and what interventions are most effective and efficient. This knowledge is important to inform policy development and practice to help children reach their potential to become productive citizens, and support the poverty alleviation and development agenda that could be achieved through education.

1.1 Purpose

This literature review on health and access to education has been prepared within the programme of work being carried about by the Consortium for Research on Educational Access, Transitions and Equity (CREATE) funded by the UK Department for International Development (DFID). The key problem being addressed by CREATE is how to increase access to education for those between the ages of 5 to 15 years through policy and programmes that are effective and financially sustainable, and which respond to the characteristics of those who are currently excluded.

The CREATE Access Model, presented in Appendix 1, forms the research framework guiding CREATE's programme of work. This framework distinguishes 4 Zones or spaces where school-aged children are vulnerable to being excluded, or are at risk of exclusion. In Zone 1 are girls and boys who have never enrolled; in Zone 2 girls and boys who drop out with incomplete primary schooling below the legal age for formal employment; in Zone 3 girls and boys who are at risk of exclusion; and in Zone 4 girls and boys who are primary completers excluded from secondary education.

To explore the link between child health and education access and achievement a health theme will be developed within the work programme of CREATE. The subjects of this research will be children who are at risk of never enrolling or of dropping out of school due to health factors. In the project areas the research will seek to identify factors linked to the health and nutritional status of the child that impact directly on educational access and retention. It will also seek to identify health (including nutrition) factors linked to the health status of the child's family members, which have an indirect impact on educational access and retention, especially for girls. It will seek to address the following research questions:

- What are the health factors that shape education access and retention?
- What are their consequences?
- How can education policy and practice be transformed to enhance access and retention?

The purpose of this literature review is therefore to:

- Synthesise the findings of published synthetic reviews of health, nutrition and educational access that include reference to DFID priority countries, including the four CREATE partner countries: India, Bangladesh, Ghana, South Africa.
- Synthesise individual studies from DFID priority countries, including the four partner countries, with a particular emphasis on issues of gender, poverty, social exclusion and innovative practices.
- Identify knowledge gaps that could be filled by new empirical research.
- Discuss the advantages and disadvantages of a range of research designs and methods employed in these studies.
- Discuss the conceptual and theoretical models of health and education that lie behind the studies.
- Draw implications from the literature review for (i) the further conceptual development of the Zones of Access model (presented in Appendix 1 and discussed below) and (ii) the design of future empirical studies.

It is hoped that this research will eventually help to develop a novel conceptual framework for educational access for 5-15 year olds who are impacted by poor health status, which integrates supply and demand, differentiates their effects on different groups, evaluates existing strategies to enhance access, and devises new policy and practice from evidence on effectiveness.

1.2 Method

1.2.1 Searching the literature

At the outset a decision was taken to exclude two sets of literature. First, the literature on increasing levels of obesity in school-age children (a risk factor for coronary heart disease, diabetes and cancer) was excluded because it is not yet a public health problem in the four CREATE countries (Ghana, South Africa, Bangladesh and India) where the future empirical work of CREATE will be located. Second, the literature on disability was excluded because another researcher was reviewing this literature for CREATE.

A systematic, step-by-step, approach was then taken to searching the literature as follows:

- A search was conducted of the Education Resources Information Center (ERIC) database using the using the following string of keywords in stages:
    - health or nutrition or wellbeing or malnutrition or malnourish developing countries or Africa;
    - gender or women or woman or female or females;
    - access;
    - education or schools or school or schooling or educational or learning or preschools or pre-school or primary school or secondary school.
- Searches were conducted of the separate databases PubMed, Popline and the Social Sciences Citations Index (SSCI) using the same string of keywords.
- Searches were conducted on the web pages of key international development agencies – UNICEF, UNESCO, UNAIDS, WHO, World Bank.

Personal communication was initiated with Prof. Sally Grantham, Dr. Matthew Jukes, Prof. Michael Kelly, Prof. Roy Carr-Hill and Prof. Don Bundy who research and write extensively in this field of study. Databases were exchanged with Prof. Grantham-McGregor and articles not yet published (but ‘in press’ or ‘submitted’) were made available by Dr. Jukes.

Key references cited in the literature collected were followed up.

The whole database was then carefully scrutinized and key references published in English were entered into the Endnote bibliography for CREATE. The following criteria were used for selecting key references:

- Recent summaries and meta-analyses of the evidence base.
- The best designed studies from all countries.

- Well designed individual studies from DFID priority countries, including the four Consortium partner countries, with a particular emphasis on issues of gender, poverty, social exclusion and innovative practices.
- The most recent statistical data and consensual views from the international development agencies.

The majority of references selected are scientific papers published in peer-reviewed journals. Also included are a number of international development agency reports, research discussion papers, proceedings of international workshops and round table meetings, and books.

1.2.2.Identifying categories and themes

The selected references were carefully scrutinized again to identify categories and themes in the literature that linked health interventions with educational access and learning. Despite some overlap these categories of literature could be discerned:

Study Design

1. The long-term effects of poor health and nutrition in early childhood and the impact of interventions on enrolment and cognition.
    a. Undernutrition;
    b. Micro-nutrient deficiency;
    c. Infectious diseases.
2. Effects of poor health and nutrition during primary school and junior secondary school and the impact of interventions on attendance, drop out and cognition.
    a. Undernutrition;
    b. Micro-nutrient deficiency;
    c. Infectious diseases.
3. Impact of HIV and AIDS on demand for and supply of education.

1.2.3 A useful entry point

Given the fast moving nature of this field of study and the complexities involved in designing good studies one reference in particular provided a useful entry point to the literature. This was a recent supplement of the Food and Nutrition Bulletin, which includes a selection of papers presented at a workshop on 'Articulating the Impact of Nutritional Deficits on the Education for All Agenda' (Galal et al., 2005). This workshop presented evidence and raised questions about the effectiveness and efficiency of current interventions and made suggestions for future research. Many of the contributors identify particular studies that they consider to be the best designed studies conducted in recent years and also provide useful summaries and meta-analyses to define the current knowledge base.

1.3 Organisation of the review

The review is organized into four chapters each focusing on one of the four major themes identified in the literature. Where relevant implications have been drawn out from the literature to show how health and nutritional factors can lead to children

finding themselves in one of the Zones shown in the CREATE Access model where they are vulnerable to being excluded from education, or are at risk of exclusion.

Section 2 addresses study design. This is a cross cutting theme that explores the complexities involved and examines what can and cannot be claimed from the different methodologies used.

Section 3 reviews research evidence on the effects of poor health and nutrition from birth to six years of age. It identifies some of the reasons why children may enter Zone 1 of the CREATE Access Model and be denied access to education or enroll late. It also reviews the evidence to suggest that poor health and nutrition in early childhood have a long-term impact on cognition during the primary and secondary school years.

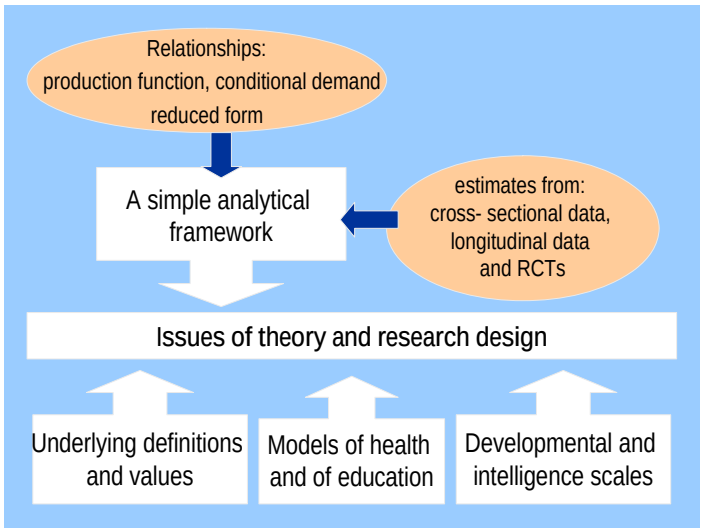
Section 4 reviews research evidence on the effects of poor health and nutrition in the primary and secondary school age years on access to education and achievement and the effects of interventions to combat these effects. It identifies some of the reasons why boys and girls may find themselves in Zone 2 of the model where they may drop out with incomplete primary schooling below the legal age for formal employment. It also identifies reasons why boys and girls may be in Zone 3 and at risk of exclusion or be silently excluded if poor health and nutrition leads to irregular attendance and achievement that is so low that they cannot follow the curriculum. The literature impacts to a small extent on Zone 4 which contains those excluded from lower secondary school as a result of dropping out before successful completion.

Section 5 focuses on HIV and AIDS. It looks at the way the epidemic impacts on educational access and achievement for boys and for girls across all 4 Zones of the CREATE Access Model. It identifies both push and pull factors that shape the actions of communities, households, parents, learners and schools that lead to crossing the threshold into exclusion.

Section 6 synthesizes the main findings from the review and draws out further implications for the conceptual development of the CREATE Access Model and for the design of future empirical studies.

2. Issues of Theory and Research Design

Figure 1 Conceptual framework for section 2



There are many studies in the literature that report associations between child health (including nutritional status) and educational outcomes (for references see Pollitt, 1990, Behrman, 1996, Walker et al., 2005). However, the relationships between child health and schooling are complex and most studies have methodological problems that can introduce bias leading to overestimations of effects. Many studies ignore the way that child health as well as child schooling reflects behavioural choices even though there is good evidence from studies that estimates may be very sensitive to the underlying behavioural assumption (Alderman et al., 2001). Earlier studies going back 20 to 30 years, which mostly use cross-sectional data, need to be carefully evaluated in the light of current understanding (Behrman, 1996).

This section explores some of the theories and issues involved in research design. It presents a simple framework to increase understanding of the difficulties involved in designing studies and interpreting the findings and considers what can and cannot be claimed from the different types of data collected. It then raises concerns about the way in which interpretation may be informed by a Western mindset and fail to take account of local attitudes and reactions to some of the intervention effects produced. It briefly discusses the conceptual models and theories of health and education that lie behind the studies and concludes with a note on Developmental Scales and Intelligence Scales.

2.1 A simple analytical framework

Glewwe (2005) presents a simple analytical framework for thinking about the relationships between health and education outcomes, including a theoretical model to demonstrate issues that arise when attempting to assess the impact of child health and nutritional status of schooling outcomes. He starts by identifying three time periods (period 1 from conception to 24 months of age, period 2 from 24 months to 5-6 years when a child is eligible to enroll in school and period 3 from 6-11years when child is of primary school age). He then develops an equation for each of the three relationships between child health and schooling that are of interest.

The first is a production function relationship, which measures the direct (structural) effect of all variables that have direct impacts on children's academic skills in time period 3, which includes health status in each of the three time periods. The other variables are parents' provision of education inputs (e.g. school supplies, books, education toys, and time spent by parents with the child that is of pedagogic value), the child's innate intelligence (ability), school (and teacher) characteristics/quality, and years of schooling. Glewwe (2005) points out that all of the required data for this equation is almost never available and that this is the root cause of almost all estimation problems. Moreover, indirect effects are also possible and not measured in this equation.

The second is a conditional demand relationship, which shows how academic skills and child health in the third time period move together according to the decisions parents make based on the values of all the exogenous variables. It takes account of the indirect effects that influence parent's provision of health and education to the child, such as health costs and tastes for education. The third is a reduced form relationship, which also takes account of the indirect effects but the health status at the three points in time have disappeared.

Glewwe (2005) explains that the third relationship is the one that should be used to measure the overall impact of a health policy or programme on children's academic skills. But if one is also interested in the mechanisms through which these different programmes work, via health outcomes then the first or second relationships need to be used. He stresses that any analysis of the impact of child health and nutrition on education outcomes must clarify what relationship is being estimated. This is important because different results in different empirical studies may not be inconsistent but just estimates of different relationships.

2.2 Type of data collected

Issues of estimation are also concerned with the type of data collected. Three types of data are available for estimating the impact of child health on education - cross-sectional (collected at one point in time), longitudinal data (collected on the same child for two or more periods of time, also known as panel data), and data from randomized controlled trails. Providing that cross sectional data contain at least one variable that measures child health and one that measures a schooling outcome of interest (often scores on academic tests) correlation can be measured. But many more variables are needed to show causal relationships and only one of these (years of schooling) is easy to collect. As Glewwe (2005) points out, most cases of cross-sectional data are therefore incomplete, which leads to omitted variable bias in estimations. Longitudinal data have the benefit that they need not be based on respondents' memories of years of schooling but are more expensive to collect. Interpreting retrospective data is complicated by the possibility that unobserved factors may determine both nutrition and health outcomes that is not necessarily causal.

Randomized controlled trials (RCTs) offer a clearer method for identifying causal relationships. They have long been the 'gold standard' for nutritionists and public health researchers but much less so for education researchers. The difficulties of making accurate estimations of the impact of child health on education have recently led to some economists to initiate and evaluate RCTs. By randomizing the population

under study into an experimental group that receives an intervention and a control group that does not, any difference in educational outcomes must be due to the intervention. Glewwe (2005) identifies a number of difficulties that have been experienced in using RCTs in practice. They can be expensive; they suffer from attrition bias especially when long-tem effects are of interest; anyone with a known treatable health problem cannot ethically be denied access to treatment being given to others; and individuals or households in the control group may gain access to the intervention. RCTs can only be used to estimate the third, reduced form relationship explained above because they only yield change in the dependent variable for the third time period.

The insights provided by Glewwe (2005) show that methodological awareness is now heightened and more nuanced and qualified than was previously recognized. This new awareness has led to the use of much more careful estimation methods in the last 10 years. Nevertheless, the two fundamental problems (lack of data on all variables in the chosen equation leading to serious problems of omitted variable bias and error in measurement of the variables that are available leading to attenuation bias) are not easy to overcome. This is a fast moving field of study and further data collection and innovative thinking will continue to lead to improved estimates.

2.3 Underlying definitions and values

Concern of a very different nature has been raised by Pollitt (2005) who argues that studies on health and nutrition interventions on school children are often guided by the definitions and values that Westernized societies give to health/nutrition (e.g. stature, activity) and educational outcomes. He considers that this may confuse interpretation of study findings from developing countries. He suggests, for example, that increased activity among school children in Zanzibar following iron supplementation might explain an increase in the repetition of grades from first-to-second-to third grade (Olney et al. 2001, cited in Pollitt 2005) because studies have shown that teachers in other sub-Saharan communities value students who sit and listen quietly without interrupting and might have a low tolerance to increased physical activity of their pupils. Consequently he stresses the need for further understanding of the cultural and economic influences on the variability of the responses of parents and teachers to some of the effects produced. He argues that in some cases these responses will moderate the effects of the interventions and such an understanding helps wise policy decisions.

2.4 Conceptual models and theories of health and education

The studies included in this literature review are concerned with identifying associations between physical health and educational outcomes. They adopt the biomedical model of health represented by the traditional scientific approaches to illness. This model of health sees the body as functioning in a mechanical way, and sees illness as the result of changes in physiological process as a result of injury, chemical imbalances, genetic defects, bacterial or viral infections, or other physical causes. Consequently, health is equated with the absence of illness, and effective treatments are seen to be those that change the physical state of the body in such a way as to correct the physical cause of illness. This approach generally involves looking for single, very specific causes for illnesses, with correspondingly specific treatments, like deworming medicine for worm infections that are expected to be

effective for that illness in most people, under most conditions. This model of health is commonly adopted in medical research with a biological orientation, where researchers are trying to identify a biological mechanism that could provide the basis for a specific physical treatment.

At the same time these studies in young children also examine the effects of psychosocial stimulation on development, and all studies (except those using randomised controlled trial designs) are much concerned with controlling for confounding factors that bias their estimations. Thus there is also recognition of a biopsychosocial model of health that takes a much more complex, 'systems theory' approach to health and illness. This broader approach sees health and illness as resulting from the interacting effects of events of very different types, including biological, psychological, social and economic factors. Health outcomes are therefore seen as resulting from the way in which all of these systems act on each other and interact with each other to affect individual health.

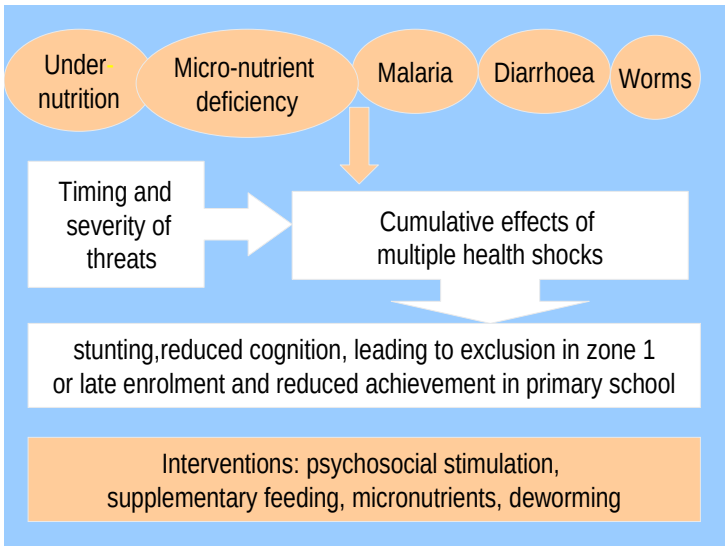
The model of education that informs all the studies reviewed is that of traditional Western schooling and informal models of education are not included.. There is one exception. In the context of HIV and AIDS there is now some lively debate about the futility of Ministries of Education in heavily affected countries running faster and faster to maintain 'business as usual'. Researchers have argued that one size no longer fits all and called for increased flexibility in delivery to allow for alternative, more relevant models of education to be developed (Pridmore and Yates, 2005).

2.5 Developmental scales and intelligence scales

The standard tests of infant development used in virtually all studies of very young children are the Bayley scales of infant development. These scales include both mental and motor development components, each standardized to have a mean of 100 and a standard deviation of 16 points. In addition, the Bayley scales include the Infant Behaviour Record, designed to assess the infant's effective state including responsiveness to the investigator, attention span, fear and other behavioural signs that might explain mental or motor test performance. The Bayley scales are not considered to be an intelligence test but a means of determining the stage of development of the infant in comparison with age-appropriate standards. In children two years and older it is possible to measure intelligence using tests such as the Wechsler Intelligence Scales for Children and the Raven Progressive Matrices.

3. Effects of Poor Health and Nutrition in the Pre-school Years

Figure 2 Conceptual framework for section 3



In developing countries, many young children are subjected to a host of developmental risk factors that can lead to some children being excluded from education in Zone 1 of the CREATE Access Model or enrolling late. These factors operate within the complex web of poverty that limit children's ability to achieve their full intellectual potential and, thus, extend the human cost of poor health and nutrition beyond general measures of mortality and morbidity (Boivin, 2002). Walker et al. (2005) point out that the cumulative threats to the health and nutritional status of young children from conception right through the pre-school years lead to one third of all under 5 year olds being stunted (i.e. having low height for age), and that stunting is associated with poor cognitive development. It is also widely recognized that iron-deficiency during infancy and the pre-school period can affect cognitive development and that both nutrition supplementation and psychosocial stimulation can improve the development of malnourished children. However, the long-term effects of these early threats are, less well understood, including the implications for school enrolment, drop out and achievement.

Recent advances in theories and research in developmental science have shed new light on the developmental effects of poverty and malnutrition (Cairns et al., 1996). These developments show that under conditions of endemic poverty adverse biophysical and social-cultural factors do not operate as independent agents but interact and can be moderated by developmental stage, health, socio-cultural and economic conditions. Pollitt (2005) found that there have been no comprehensive studies that have responded to these developments. He calls for more studies to follow children from birth to adulthood and measure the independent cumulative effects of poverty, poor health and malnutrition on intellectual development and education through the generally recognized developmental periods, across a variety of eco-cultural settings.

Several recent summaries of the research evidence to link long term effects of health and nutrition in early childhood with educational outcomes are available (Jukes, 2005;

Grantham-McGregor and Baker-Henningham, 2005; Glewwe et al., 2001a). These summaries look at education outcomes during the primary and secondary school years and consider the effects of nutritional deficiencies and infectious diseases. They identify a number of factors that may result in children in Zones 2 and 3 being excluded from education through attending irregularly or dropping out. In developing countries the debates focus on the threats to child health and education caused by undernutrition leading to stunting (measured as low height-for-age), deficiencies of essential nutrients such as iron, iodine and vitamin A, and parasitic worms. There is also some literature around malaria and diarrhoeal diseases. Running through all these debates is an overriding concern about the cross-sectional nature of many studies and the way in which the effects of health and nutrition are obscured by the multitude of factors that affect schooling outcomes.

3.1 Nutritional deficiencies

3.1.1 Timing of interventions

Developmental risks are agreed to be greatest in early childhood and the timing of malnutrition is therefore a critical factor in determining subsequent cognitive development. There is less agreement on precisely when in the first two years of life the largest effects of child health on school outcomes are experienced.

Analyses of data from the Cebu Longitudinal Health and Nutrition Survey in the Philippines suggest that the largest effects are from conception until the child is 24 months old (Glewwe et al., 2001a) and that malnutrition in the second year of life may have a larger negative impact on later cognition than malnutrition in the first year of life (Glewwe and King, 2001b). Another study using the Cebu data found that children stunted in the first six months of life were more likely to have impaired cognition than those stunted later, but the relationship was confounded by the children stunted earlier being more severely stunted (Mendez and Adair, 1999).

A review of selected studies by Grantham-McGregor and Baker-Henningham (2005) concluded that the limited evidence suggests that developmental benefits are more likely to be sustained if nutritional supplementation begins in late pregnancy or at birth and is continued until the child is at least 24 months old. Supplementation begun in older children was found to have little or no effect but there were too few studies to conclude this with confidence and most studies failed to separate the effects of energy and protein from those of micronutrients. A review by Jukes (2005) concluded that there is currently no strong evidence that intervention with children at risk of or suffering from malnutrition in the first year of life is more effective than intervention at a later age.

3.1.2 Nutrition in utero and the effects of breastfeeding

Low birth-weight babies and those born small for their gestations age are known to be at risk of poor developmental outcomes in the long-term. A study in India found a small long-term effect for babies born small for their gestational age on the mental performance of adolescent boys (aged 10-12 years) but poor nutrition in early childhood had a greater impact than being small at birth. Breastfeeding has been

shown to be associated with moderate long-term improvement in cognitive development but little work has been done in developing countries. A meta-analysis of 17 studies of observed differences in cognitive development between breast-fed and formula-fed children concluded that breast-feeding was associated with significantly higher scores for cognitive development than was formula feeding (Anderson et al., 1999). A more recent review of the evidence base concluded that although the evidence was strongly suggestive of a link between breastfeeding and cognitive ability in later life, it was not conclusive (Jukes, 2005).

3.1.3 Nutrition and psychosocial stimulation

Jukes (2005) reviews evidence from interventions in preschool and infancy to improve nutritional status in developing countries. He found only five randomized studies that have evaluated the long-term impact of health and nutrition interventions conducted in the pre-school years (Grantham-McGregor et al., 1994; Pollitt et al., 1997; Walker et al., 2000; Chang et al., 2002; Jukes et al., in press). Most of these studies focused on undernourished children and yielded evidence to suggest that improving the health and nutrition of young children can improve their subsequent chances of attending school, the gender equity of education access, and performance of children once at school. Jukes identified a gap in the evidence base for the long-term effects of other early childhood interventions, such as iron supplementation, on access to education.

Grantham-McGregor (2005) also reviews evidence from studies on health and nutrition in early childhood. She concludes that there is reasonably good evidence that early childhood malnutrition, moderate and severe stunting and underweight (low weight-for-age) are associated with poor cognitive development, behaviour and academic attainment in later childhood.

Malnutrition is classified as mild, moderate or severe. Overall there is good evidence to show that severe malnutrition in early childhood has a substantial long-term effect on child development. A landmark quasi-experimental study in Jamaica followed up children who had been hospitalized with severe malnutrition at 6-24 months of age. The investigators found that at 7, 8 and 9 years of age these children had lower developmental levels than a control group of children who were not malnourished and had been hospitalized for other reasons. At the 14 year follow-up the malnourished group had markedly lower overall IQ (1.50 SD below the control group) (Grantham-McGregor et al., 1994).

A review of the literature by Grantham-McGregor (1995) found evidence that the disadvantages lasted at least until adolescence but that there was no consistent evidence of a specific cognitive deficit. She concluded that evidence of a causal relationship was strong but not unequivocal (because of difficulties in interpreting retrospective case control studies). She found evidence that marked improvements in development can occur after intervention depending on the quality of the subsequent environment. There was also limited evidence that other nutritional deficiencies may interact with previous malnutrition in affecting cognition.

Whereas severe malnutrition rates are generally low, rates of mild and moderate malnutrition are very high in developing countries and therefore of more concern. A

study in Jamaica identified stunted and non-stunted children at age 9 to 24 months, and the stunted children were enrolled on a 2-year randomized trial of nutrition supplementation, or psychosocial stimulation, both or neither. At the end of the interventions supplementation and stimulation were found to have had independent benefits on the children's development (e.g. receiving nutrition supplementation did not improve the effectiveness of stimulation) and the effects were additive (receiving both was better than only one). Nutritional supplementation accounted for an increase of 6.1 DQ points (0.66 SD), an IQ equivalent for infants and young children and the stimulation accounted for an increase of 7.3 points (0.79 SD).

A follow up of these children at 5-6 years of age found that the perceptual-motor skills of the children showed a significant benefit from stimulation but nutrition supplementation had only benefited children whose mothers had higher verbal intelligence quotients. (Grantham-McGregor et al., 1997) A subsequent follow up when the children were 11-12 yrs of age showed that early psychosocial stimulation had a small but significant long-term benefit. However, stunted children had significantly poorer performance than non-growth-restricted children on a wide range of cognitive tests, supporting the conclusion that growth restriction has long-term functional consequences.(Walker et al., 2000) The stunted children also had more behavioural difficulties at home, regardless of their social background, than non-stunted children. Their educational attainment was also poorer than non-stunted children in arithmetic, spelling and reading tests (Chang et al., 2002).

A final follow up study of these children at age 17-18 years again recorded no significant effects of nutritional supplementation but compared with no intervention, stimulation resulted in higher IQ, verbal and reading scores. Overall, stunted non-stimulated participants had significantly poorer scores than the non-stunted group on 11 of 12 cognitive and educational tests. The study concluded that stunting in early childhood is associated with cognitive and educational deficits in late adolescence, which are reduced by stimulation at a young age (Walker et al., 2005).

Whilst this study showed long-term benefits from a 2 year supplementary feeding intervention, another study, also in Indonesia, showed that even a 3-month programme of supplementation can have long-term effects. Ten years after the intervention children who had been supplemented scored significantly higher on tests of knowledge, numeracy, reading and vocabulary and had faster reaction time in information processing tasks (Pollitt et al., 1995).

But not all studies endorse these findings. A trial of nutritional supplementation and psychosocial stimulation in growth stunted children aged 9-24 months in Jamaica showed that eight years after the intervention ended there were no significant benefits from nutritional supplementation to growth or cognition although psychosocial stimulation had a small but significant benefit on cognition. The stunted children had significantly poorer performance than non-stunted children on a wide range of cognitive tests, supporting the conclusion that growth restriction has long-term functional consequences (Walker et al., 2000).

3.1.4 Effects of undernutrition on school enrolment

A number of studies have suggested that chronic mild malnutrition leading to stunting can lead to children being enrolled later than their peers or not at all, and that girls are disproportionately affected in countries where boys are more highly valued (Partnership for Child Development 1999). Given concerns about methodology of some studies this review will start by reviewing the three studies that link poor nutrition in the early years to late school enrollment, which have been identified by Gleewe (2005) as the best analyses done in recent years.

The first study carried out an economic-analysis on cross-sectional data on 1757, 6-15 year olds from the Ghana Living Standards Survey to assess the link between early childhood nutrition and delayed primary school enrollment and final ultimate grade attainment. The estimates used height-for-age as the indicator of child health status. Based on an analysis of sibling difference the study found that early childhood malnutrition causes delayed enrollment and there was little support for any other alternative explanations of delayed enrollment such as family income. Late enrollment was not associated with borrowing constraints or the rationing of places in school. The investigators conclude that their findings have potentially important policy implications and argue that better nutrition in early childhood can lead to substantial increases in lifetime wealth (Glewwe and Jacoby, 1995).

The second study collected longitudinal data from 1986 to 1991 on more than 800 households drawn from 45 villages in 3 relatively poor districts in rural Pakistan to investigate the impact of child health (as indicated by nutritional status) on school enrollments. The estimates use food price shocks during the preschool years as instrumental variables for child health status to control for behaviour determining the child health stock measure. The investigators found that child health (measured as height-for age) at 5 years of age had a strong positive effect on the probability of being enrolled in school by the age of 7 years, especially for girls. They conclude that improvements in child pre-school nutrition are likely to have long term productivity effects by leading to more schooling in general and helping to reduce the gender gaps in schooling and in subsequent productivity gains in particular (Alderman et al., 2001).

The third study used cross-sectional data from more than 2,000 households from the Cebu Longitudinal Health and Nutrition Survey in the Philippines, to estimate the impact of child nutrition on academic skills. A large sample of children were surveyed shortly before their birth in 1983 and 1984 and followed up to the end of their primary education. Unlike the previous two studies cited, this study attempts to estimate the production function relationship rather than the conditional demand relationship (as explained in section 1.3) Based on analysis of sibling difference from 1239 sibling pairs using height-for-age as the measure of child health status the study found that the primary school enrolment of malnourished children tended to be delayed, probably because they were deemed unready for school at the minimum age of enrollment. The study also found that malnourished children perform more poorly in school, partly because they enter later and have less time to learn (Glewwe et al., 2001a).

Another frequently cited study using the Cebu data from the Philippines endorsed these findings. The investigators explored the association between height-for-age Z-score (HAZ) at 2 years and schooling trajectory among 2198 children and schooling outcomes (entrance age, grade repetition, and grades completed). The findings showed that, after adjusting for confounding factors, greater height for age protected against late enrollment among both boys and girls and predicted early enrollment among boys. Taller boys and girls were less likely to repeat grades and less likely to drop out during grade school rather than graduate from high school. The study concluded that improving early childhood nutrition may have long-lasting educational benefits and increase the likelihood of high school completion in developing countries (Daniels and Adair, 2004).

One large study in rural schools in Ghana, Indonesia, Kenya, Malawi, Mali, Mozambique, Tanzania and Vietnam assessed the prevalence of anaemia amongst nearly 14 000 children enrolled in basic education in three age ranges (7-11 years, 12-14 years and 15 years and over). This study found that children who enrolled late in school were more likely to be anaemic than children who enrolled closer to the correct age (Hall et al., 2001).

3.1.5 Iron deficiency anemia

Iron deficiency anemia (IDA) is one of the world's most widespread health problems, especially among children. Approximately 40 percent of children are anaemic across various African and Asian settings (Hall et al 2001). Iron-deficiency anaemia is caused by poor diets and loss of blood due to worm infestations. Vitamin A is needed for the full absorption of iron and deficiency exacerbates anaemia. Anaemia leads to weakness, poor physical growth, and a compromised immune system – decreasing the ability to fight infections and increasing morbidity.

- Over the past three decades, there have been a considerable number of studies on the relationship between iron status, cognition, and behaviour showing that young children who suffer from iron-deficiency anaemia frequently perform worse in tests of mental and motor development than do iron-sufficient infants of a comparable age and behave differently from those who are not iron deficient. They tire more easily, are less socially interactive, show less delight and pleasure, are more hesitant and cling to their carers more. In response carers tend to interact with these children less often, which is important because it leads to anaemic children receiving lower levels of stimulation. Despite the wealth of studies the question of whether a causal relationship exists between iron deficiency and lower cognition remain controversial.

- Horton and Ross (2003) review observational studies and note that they are remarkably consistent in finding that infants with moderate iron deficiency anaemia have test scores 0.5 to 1.5 standard deviations lower than those infants with sufficient iron stores. They point out that these differences are large enough to be of great concern, especially given the high prevalence of child anaemia in poor environments. However, observational studies have confounding factors, not all of which can be controlled for.

- Only two randomised controlled trials have been conducted. An earlier study, a double-blind randomised intervention with anaemic children aged 17 to 19 months

received either daily supplements of iron and vitamin C or vitamin C only (control group) for two months. The study found that 31% of children receiving the iron and vitamin C supplementation gained weight versus only 12% of those receiving the placebo and more of them achieved the expected rate of development (Aukett et al., 1986).

- A more recent study in Indonesia used a randomised, double-blind design to monitor the effects of iron supplementation on mental and motor development among infants aged 12 to 18 months. Iron-deficient anaemic infants were assigned randomly to treatment or placebo groups for 4 months. Similar treatment randomisation was done among non-anaemic iron-deficient and iron-sufficient infants. After intervention, those receiving the iron supplementation showed impressive gains on the Bayley Scales of Infant Development. Their Mental Development Index roles by 19.3 points (1.3 SD) and the Psychomotor Development Index rose by 23.5 points (1.6 SD). Neither iron supplementation nor placebo had significant effects on the scores of the non-anaemic iron-deficient and iron-sufficient infants. These results show that the poor performance of iron-deficient anaemic infants aged 12 to 18 months can be substantially improved by iron supplementation (Idjradinata and Pollitt, 1994).

A review of selected intervention studies on the effect of iron deficiency on children's cognition and behavior was conducted by Grantham-McGregor and Ani (2001) to seek evidence of a causal relationship. They found that in anaemic children under 2 years old, short-term trials of iron treatment have generally failed to benefit development, most longer trials lacked randomised placebo groups and failed to produce benefits and only the small randomised controlled trial by Idjradinata and Pollitt cited above has shown clear benefits. They therefore concluded that it remains uncertain whether the poor development of iron-deficient infants is due to poor social backgrounds or irreversible damage or whether it can be remedied with iron treatment. For children more than 2 years old they found that the few preventative trials either have design problems or produced no benefits or only questionable benefit. They considered that the evidence from the randomised controlled trial was reasonably convincing but not conclusive. They called for more randomised controlled trials of iron treatment especially in younger children.

A study by Lozoff et al. (2003) is the largest preventative trial of iron supplementation in infants to date. The investigators used a quasi-experimental design, adequate measures of iron status and more comprehensive developmental measures than previous studies. They found no effect on the children's scores on the Bayley Scales or a test of recognition memory but a benefit was found in speed of information processing, behaviour, and age of creeping. It is difficult to make accurate estimations for the data because the low and high iron groups were separated in time and consumed different amounts of cow's milk. It is therefore not possible to infer with confidence that iron deficiency caused these small differences. Grantham-McGregor (2003) notes that although there is consensus that severe anaemia is harmful more randomised controlled trials are needed to determine whether mild or moderate anaemia affects children's development and to what extent.

A more recent review by Grantham-McGregor (2005 p.S114) reiterates that there is reasonably good evidence that iron deficiency anaemia is associated with poor cognitive development, behaviour and academic attainment in later childhood. A

recent review by Jukes (2005) similarly concluded that current evidence from all trials suggests that iron supplementation can improve the development of children under 2 years of age if sustained over a sufficiently long period of time (12 weeks).

3.1.6 Vitamin A deficiency

Mild or sub-clinical vitamin A deficiency causes impaired immune function leading to increased severity of some infections and an increased risk of mortality from infectious diseases. Vitamin A deficiencies makes it difficult for children to see in dim light (know as night blindness) and severe deficiencies are an important cause of blindness (from xerophthalmia) in children. It is estimated that 85m children are at increased risk of acute respiratory and other infections because they are deficient in vitamin A. Vitamin A also affects iron metabolism so that improvement in iron status will be reduced when vitamin A status is low. The most susceptible group for vitamin A deficiency blindness is preschool children. The UNICEF child survival programme seeks to combat vitamin A deficiency by administering five doses of vitamin A to all children under three years of age. In Bangladesh this programme reaches 90% of under five year olds (Drake et al., 2000) and in India it reaches 72.6% of infants and 54.8% of 1-2 year old children (WHO, 2006).

3.2 Infectious diseases

As mentioned in chapter 1, children suffer a heavy burden of diseases that can affect cognitive development in infancy and the pre-school years. These diseases are mainly malaria, and intestinal parasites, including protozoa (such as Giardia lamblia that causes diarrhoea) and worms, also known as helminths. Anaemia can be caused by lack of iron in the diet and by worm infestations that cause blood loss from the gut wall.

3.2.1 Malaria

Globally there are one million deaths from malaria each year and the vast majority are in children under five years of age for whom malaria remains the major cause of death and repeated episodes of the fever caused by cerebral malaria reduce a child's ability to learn (WHO and UNICEF, 2005). Of those who survive around 10% suffer neurological problems that effectively prevent them from attending school (Jukes, 2005).

One study in Kenya compared the performance of 87 children aged 6 to 7 years who had been hospitalized due to cerebral malaria with impaired consciousness 3 to 4 years after hospitalization to a group of children who had been hospitalized for other reasons. Compared to matched community controls the severe malaria group was found to be significantly less able to initiate, plan and carry out tasks (the executive functions). Children in the severe malaria group were 4.6 times more likely than those in the control group to suffer cognitive impairment ranging from severe learning difficulties requiring care to mild genitive impairments. (Holding et al., 1999) Similar results have been reported from a study in Senegal which also showed that rural children were at greater risk for cerebral malaria (Boivin, 2002). Further studies have shown that cerebral malaria can increase the risk of epileptic episodes causing

cognitive impairment or psychotic episodes and that even less severe bouts of malaria can lead to poorer balance (Jukes, 2005). A randomized controlled trial in the Gambia investigated the long-term impact of preventing malaria on later cognitive development. The study found that under five year olds who were protected from malaria for three malaria transmission seasons had improved cognitive performance on tests of both short and long term memory at age 17 years but the study had a number of possible limitations. The investigators conclude that the results are suggestive of an effect of malaria prophylaxis on cognitive function and educational attainment, but acknowledge that confirmatory studies are needed. They concluded that the findings are suggestive of a long-term effect on children's cognitive development and education and stress that, given the high prevalence of malaria, any effect it has on cognitive function is likely to result in a massive cumulative loss around the world (Jukes et al., in press).

3.2.2 Diarrhoea

Inadequate access to clean water, lack of adequate sanitation facilities and poor hygienic practices are the primary causes of diarrhea, which kills between 1.6 million and 2.5 million young children each year, more than any other illness or disease. Most of these children are under five years of age. It threatens growth and exacerbates malnutrition. A study in Peru (Berkman et al., 2002) assessed the effect of stunting, diarrhoeal disease, and parasitic infections during infancy on cognitive function in late childhood. The researchers followed up from birth to 2 years, a cohort of Peruvian children keeping records of body measurements (anthropometry), analysis of stool samples, and diarrhoeal status. At 9 years of age, they assessed cognitive function and found that children with severe stunting in the second year of life had an IQ 10 points lower than children without severe stunting. Children with more than one episode of diarrhea (Giardia lamblia) per year scored 4·1 points lower than children with one episode or fewer per year. The authors conclude that malnutrition in early childhood, indexed by stunting, and potentially Giardia lamblia, are associated with poor cognitive function at age 9 years. They argue that if the observed associations are causal, then intervention programmes designed to prevent malnutrition and Giardia lamblia early in life could lead to significant improvement in cognitive function of children in similar lower-income communities throughout the less-developed world.

3.2.3 Worms

Worms are one of the most common infections in the world, especially in warm moist tropical and sub-tropical climates and children in developing countries are the most severely affected. It is well recognized that climate specific-frequencies are moderated by levels of sanitation as well as cultural and childcare customs (see further references in Grigorenko et al., Submitted).

There are two main types of intestinal worms: nematodes (such as whipworm and hookworm) and trematodes (such as schistosomes). The impact of worms on health and growth is commonly believed to be most significant in children after they reach the age of five. However, a recent study in India links worm infection with growth faltering in children between one and four years old. This randomized controlled trial evaluated a health programme that delivered deworming drugs and iron supplementation to 2-6 year old children through an existing pre-school network in the slums of Delhi. Even though only 30 percent of the sample children had intestinal worm infections, 69 percent had moderate to severe anaemia. The sample pre-schools

were randomly divided into groups and gradually fazed into treatment. After 5 months of treatment, the investigators found that weight had increased significantly among treated children, and a one-fifth reduction in school absenteeism. At follow-up after two years the investigators found similar estimates but high sample attrition and non-random enrollment of new children into the treatment groups complicated attempts to obtain unbiased estimates (Bobonis et al., 2004). This study was identified by Glewwe (2005) as being among the best randomized evaluations conducted in recent years.

An earlier study, also in India used a single blind, placebo-controlled design with child as the unit of randomization to measure the effectiveness of the deworming medicine albedazole in improving the nutritional status of preschool children in urban slums. Six-monthly deworming was able, within two years, to prevent 82% of the stunting that occurs without intervention, dewormed children showed an impressive 35% weight gain. The investigators concluded that six monthly albendazole reduces the risk of stunting with only a small increase in the expenditure on health care but larger trials are needed to study the effect of albendazole on prevention of stunting, cognitive functions and all-cause childhood mortality (Awasthi et al., 2000). The benefits of regular deworming of pre-school children have been confirmed in recent cluster randomised controlled trial in Uganda demonstrated that in children 1-7 years old 1 and 7 years anthelmintic treatment offered as a part of child health services in Uganda over three years resulted in an increase in weight gain of about 10% when treatments were given twice a year, and an increase of 5% when the treatment was given annually (Alderman et al., 2006).

3.3 Summary

This review of the research evidence on the effects of poor health and nutrition in the pre-school years has highlighted the way in which young children are challenged by multiple developmental risk factors. These risk factors are exacerbated by poverty and by socio-cultural attitudes and behaviours towards health and education that operate within the family. When trying to demonstrate a causal link between health and education access, school enrolment and these 'environmental factors' cause problems of confounding in the vast majority of studies that use cross-sectional and longitudinal designs.

Nevertheless, the chapter has identified some of the health and nutritional reasons for children being denied access to education and entering Zone 1 of the CREATE Access Model. Perhaps the most serious assault is from cerebral malaria, which can cause severe neurological problems that effectively prevent affected children attending school. Even less severe bouts of malaria may reduce later cognition. This is of great concern given the high prevalence of malaria in developing countries and the known preventative measures.

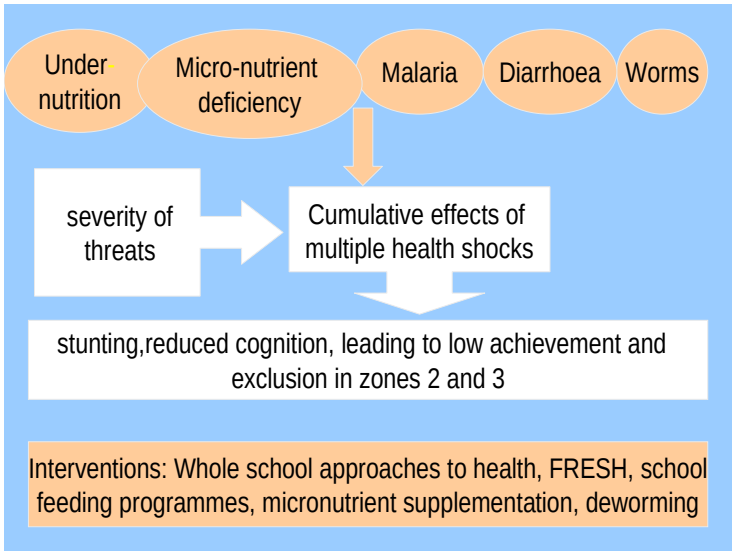
Although other health and nutritional assaults may not completely deny access to education there is reasonably good evidence to show that iron-deficiency anaemia leads to a long-term reduction in cognitive achievement and that stunting and worm infestation causes delayed enrollment. This may lead to an overall decrease in the amount of schooling received and lower achievement. It may also lead to a decrease in lifetime wealth, which is especially important in poor communities where there is a fine line between being poor and living in abject poverty.

Although the evidence suggests that children are especially sensitive to health and nutrition assaults in the first two years of life, the jury is still out as to whether the first or second year is the best time to intervene.

There is clearly a need for more RCTs to demonstrate causality but studies are also needed in different contexts to increase understanding of the socio-cultural and economic influences on developmental risk factors and on the variability of the responses of parents and teachers to some of the intervention effects produced. At the same time there are many affordable and pro-poor strategies such as deworming, improving hygiene, water and sanitation and increased access and use of insecticide treated bed nets to protect against malaria that can be implemented to improve children's health and their access to education.

4. Effects of Poor Health and Nutrition in the Primary and Secondary School Years

Figure 3 Conceptual framework for section 4



Available data indicate that there are high levels of malnutrition and poor health among children in many developing countries (see section 1). But what are the effects on educational outcomes during the primary and secondary years? Over the past 30 years many studies have attempted to address this question and the evidence base was recently reviewed at an international workshop on articulating the impact of nutritional deficits on the Education for All agenda (Galal et al., 2005). This chapter will use the meta-analyses presented as an entry point to this literature and also identify individual studies from the four partner countries that have a particular emphasis on issues of gender, poverty, social exclusion and innovative practices.

In reviewing this literature this section aims to identify reasons why some boys and girls find themselves in Zone 2 of the CREATE Access Model and drop out with incomplete primary schooling below the legal age for formal employment. It also identifies reasons why boys and girls may find themselves in Zone 3 may where they are at risk of exclusion or are silently excluded if poor health and nutrition leads to irregular attendance and achievement that is so low that they cannot follow the curriculum. The literature also impacts to a small extent on Zone 4 where children are excluded from lower secondary school as a result of dropping out before successful completion.

The section starts by considering the timing of interventions and then examines the evidence base on nutritional deficiencies looking particularly at the educational outcomes of school feeding and micronutrient supplementation interventions. Lastly, it reviews literature on infectious diseases and cognition paying particular attention to the impact of deworming on school age children, which is gaining recognition on the international agenda and has a high research focus.

4.1 Timing of interventions

Poor health and nutrition in the developing world are key pathways through which poverty is translated into poor educational outcomes. The effects of living in impoverished communities are cumulative and there are important interactions between nutrition and health. For example, parasitic infections increase malnutrition and both conditions depress the body's immune system increasing vulnerability to other infections. Pollitt (2005) presents evidence from studies to shown that young children who are malnourished and ill carry acquired initial disadvantage, compared to similar children from middle-class parents, for the learning of later competencies taught in formal schools. Studies also show that these disadvantaged children will continue to experience the cumulative effects of their poor socioeconomic background throughout their schooling and that this disadvantage will endure if they drop out of school before or at the end of the primary cycle. The question arises as to when it is most effective to intervene in this process. Literature on this question is scarce and the need for further studies has been recognized (Bundy, 2005).

One study analysed data from the National Longitudinal Survey of Youth in the USA (which measures each child's cognitive development repeatedly over time) to determine whether cognitive outcomes are influenced more by poverty during childhood or the length of exposure to poverty regardless of the life stage in which the child is exposed to poverty. The investigator distinguished between ability determined by both environmental and genetic factors early in life, and acquired achievement. The findings show that although long-term poverty has substantial influences on both ability and achievement, childhood appears to be a much more crucial period for the development of cognitive ability than early adolescence. In contrast, poverty experienced in adolescence appears to be more influential to adolescent achievement than poverty experienced earlier in life (Guo, 1998).

4.2 Nutritional deficiencies

4.2.1 General overview

There is a good body of literature to show that school-aged children who suffer from protein-energy malnutrition, hunger, or who lack certain micronutrients in their diet (particularly iron, iodine or vitamin A) do not have the same potential for learning as healthy and well-nourished children. Studies have suggested that such children attend school less frequently, are more likely to repeat grades, drop out early and fail to learn adequately due to poor attention, low motivation and poor cognitive function (Pollitt, 1990, Grantham-McGregor and Walker, 1998, Rosso and Marek, 1996). Three summaries of the evidence are available.

A summary by Glewwe (2005) concluded that most of the best recent studies have found sizeable and statistically significant impacts of school child health and nutrition on education outcomes. Glewwe argues that despite the many estimation problems there is no reason to think that these problems systematically overestimate the impact and therefore there does seem to be a strong causal link from child health and nutrition to education outcomes. Glewwe identifies two areas for future research (i) further analysis of longitudinal data to understand the processes behind these links and stimulate new thinking about possible policy interventions (ii) more randomised

evaluations, which compare their findings with standard cross-sectional or longitudinal estimates based on the control group data and make it clear which of the three types of relationship discussed in chapter 2 are being compared, in order to create a record of the likely bias of non-experimental methods (Glewwe, 2005).

A summary by Bundy (2005) found that there is now reliable evidence that ill health and malnutrition affect access, participation, completion and achievement, and that school-based health and nutrition programmes can provide a cost effective and low-cost solution. Bundy traces the way in which school health programmes have moved over the last 20 years away from using a medical approach that favoured elite schools in urban centers towards being more socially progressive and specifically targeted towards the poor, girls, and the most disadvantaged children. He notes with satisfaction that the need for school health and nutrition programmes as part of Education for All (EFA) actions is now recognised both by countries and development partners worldwide, and presents examples of successful practical sector programmes that have gone to scale for both low- and middle- income countries. He notes that a major step forward in international co-ordination of school health programmes was achieved when a framework to 'Focus Resources on Effective School Health (FRESH)' was developed jointly by UNESCO, WHO, UNICEF, Education International and the World Bank. This framework was launched at the World Education Forum in Dakar, 2000, and carried the clear message that good school health, especially water, sanitation and nutrition, is a key component of efforts to achieve EFA.

Bundy identifies two key unresolved issues related to the targeting of nutrition interventions toward school-age children for future research. The first concerns the role of food as an incentive for participation in education, and the second concerns the appropriate target age group for nutrition interventions. There have also been calls for research in two further areas. First, to studies to bolster evidence for the effectiveness multi-faceted interventions such as those promoted by the FRESH framework (Nemer et al., 2001). Second, for more evaluations of large-scale nutrition interventions in developing countries.

4.2.2 School feeding programmes

Two main strategies have been used to improve the nutritional status, attendance rates and cognition of school age children

1. The provision of meals and snacks for eating in school

2. Food for Education (FFE) interventions in which food given at school may be taken home.

These strategies are underpinned by hypothetical pathways that link the provision of school meals with improved education access and achievement, in two ways. Firstly, educational outcomes may improve through increased enrolment and time in school due to reducing the cost to the parent of sending a child to school and benefits to the family from providing take home food. Secondly, educational outcomes may improve through enhanced attention, cognition and behaviour resulting from relief of hunger and from better nutritional status (if the quality and quantity of food is adequate and the supply continues for some time).

The provision of meals and snacks for eating in school:

Grantham-McGregor and Walker (1998) reviewed studies showing associations between current nutrition and school performance (enrollment, attendance, achievement, classroom behavior, and school drop-out). They found a large number of studies that showed children who were stunted, anaemic, or iodine deficient had poorer school achievement levels and attendance than other children. Fewer studies had examined the experience of hunger, missing breakfast, or poor dietary intakes but most found associations with school performance.

In a more recent review of the evidence Grantham-McGregor (2005) notes that further associations have been reported between experience of hunger and children's psychosocial function or behaviour, academic attainment and attendance. She points out, however, that most studies have failed to control adequately for all possible socio-economic background variables associated with hunger, which are likely to independently affect children's school performance. Rigorous short-term studies of missing breakfast have generally shown detrimental effects on children's cognition whereas studies of providing breakfast have shown benefits particularly in malnourished children. But classroom conditions may modify the effects of breakfast on behavior.

In this review Grantham-McGregor found that there have been very few longer-term studies of the effects of giving school meals and nearly all involved breakfast. She notes that it has proved extremely difficult to run robust trials of school feeding, partly because feeding children tends to be an emotional and politically sensitive topic, which makes it difficult to have children in a control group. She found only one longer term randomized controlled trial, conducted by Powell et al. (1998), which found benefits associated with attendance and arithmetic performance. This study is reviewed further below. Less robust studies comparing participants with non-participants or comparing matched schools have found benefits of receiving breakfast but there was bias due to self-selection and schools may have been inadequately matched. Grantham-McGregor concludes that most studies of giving breakfast have found benefits to school performance through increased attendance and retention. However, many had serious design problems, were short-term, and were not conducted in the poorest countries. She argues that in order to advise policy makers correctly, there is an urgent need to run long-term randomized controlled trials of giving school meals in poor countries and to determine the effects of age and nutrition status of the children, the quality of the school, and the timing of the meal. She emphasizes that the special needs of orphans should also be considered.

The study by Powell et al. (1998) demonstrated that hunger during school may prevent children in developing countries from benefiting from education. The investigators conducted a randomized, controlled trial of giving breakfast to undernourished (weight-for-age more than or equal to –1 SD of the national reference standards) and adequately nourished children (weight-for-age less than 1 SD) in rural schools in Jamaica. Both groups were stratified by class and school, and then randomly assigned to breakfast or control groups. After the initial measurements, breakfast was provided every school day for 1 school year. Children in the control group were given one-quarter of an orange and the same amount of attention as children in the breakfast group. All children had their heights and weights measured

and were given the Wide Range Achievement Test before and after the intervention. School attendance was taken from the schools' registers. Height, weight, and attendance improved significantly in the breakfast group compared to the control group. Both groups made poor progress in Wide Range Achievement Test scores but younger children in the breakfast group improved in arithmetic. The investigators concluded that the provision of a school breakfast produced small benefits in children's nutritional status, school attendance, and achievement and suggest that greater improvements may occur in more undernourished populations.

Compared to school feeding programmes, Food for Education (FFE) includes a broader range of interventions designed to improve enrollment, attendance, community-school linkages, and learning. The United Nations World Food Programme (WFP) is the largest organizer of FFE throughout the world. In 2003 WFP provided food to schools in 70 countries, accounting for more than 15 million children. Once school feeding programmes have been launched, complementary activities such as de-worming and HIV prevention education can 'piggyback' these programmes to maximise the benefits of food aid. (World Food Programme, 2003). FFE involves the distribution of food to "at-risk" children (usually girls, orphans or other vulnerable children) who attend school regularly as a stimulus to increase participation, and to help offset some of the opportunity and cash costs of educating children. The food may be locally grown and purchased or contributed by aid donors. It is generally given as a take-home ration to be eaten by a family that regularly sends a child to school or sold to increase family income, but food may also be given to eat as in-school meals or snacks to reduce short-term hunger and its associated cognitive effects. Where FFE also includes food-for-work, targeted to teachers or parents involved in activities to improve schooling outcomes, it can be used to boost efforts to improve both the demand (enrollment and attendance) for education and the supply (quality) of education, which are of course interrelated and mutually reinforcing.
Levinger (2005) points out, however, that to be effective FFE interventions must reflect local education supply and demand realities. She argues that if such responses result in contextually appropriate designs then FFE can be a powerful tool for development but warns that the potential of FFE can only be realized if a full analysis of the supply and demand blockages is undertaken. She presents the 4 scenarios shown in figure 4.1 to illustrate that selection of a particular FFE strategy must be context specific. For example, where educational quality is high but demand low FFE can best be used to improve recruitment, but where quality is low but demand high it needs to be used to modify what happens in the classroom.

Figure 4 Contextualising food for education according to education demand and quality levels

Demand low / Quality low Use food as incentive to attract more students and to improve children's active learning capacity		**Demand low / Quality high** Use food to attract out-of-school children and to retain those in school
Demand high / Quality high Consider phasing out or scaling back feeding activity		**Demand high / Quality low** Use food to improve active learning capacity, community involvement, and teacher skills

Source: Levinger, 2005. S176

FFE interventions are still relatively new and although there has not yet been time to build up a solid body of literature to evaluate them a few studies are available. One study in Bangladesh used a government FFE programme to successfully get parents to send girls to school (Ahmed and Ninno, 2002). In this programme a free monthly ration of foodgrains is supplied to more than poor families if their children attend primary school. The programme started in 1993 and by 2000 27% of all primary schools were enrolled. The family could consume the grain, thus reducing its food budget, or sell the grain and use the cash to meet other expenses. Primary data were collected from multiple surveys covering primary schools with and without the FFE program, households including programme beneficiaries and non-beneficiaries, communities, and foodgrain dealers. In addition to the surveys, academic achievement tests, designed to assess the quality of education received by students, were given to students enrolled in both FFE and non-FFE schools. Based on these data, the investigators used a variety of quantitative and qualitative methods to evaluate the FFE program. Since the inception of the program in 1993, the number of teachers per school had remained virtually constant. The investigators found evidence from the school survey to suggest that FFE had been successful in increasing primary school enrollment, promoting school attendance, and reducing dropout rates. Furthermore, the enrollment increase was greater for girls than for boys.

The importance of school feeding programmes is discussed by Levitsky (2005) who notes that the most robust finding from the evaluations of these programmes is that they increase attendance and asks why governments have not used this evidence to initiate more school feeding programmes for the poor. He suggests that the gap between research and policy development has arisen because the research agenda has been primarily aimed at fellow researchers rather than policy makers. He argues that it is not sufficient to show that health and social programmes have beneficial outcomes for individuals, there is also a need to demonstrate that the financial investment in such programmes will save government money. He points out that to do this we need to know how much return a government gets for its investment in children's nutrition

programmes. He suggests that lessons can be learned from the experience of other programmes such as 'Head Start' in the USA, which prepared pre-school children for entry into primary education. Investigates were able to show that children who attended the programme were less likely to be retained in later grades, less likely to need special education, significantly more likely to graduate form school and less likely to engage in criminal behaviour and get arrested than were children who did not attend the programme. Levisky argues that there is a need for more research to make similar links between school feeding programmes and their long-term financial and social benefits in order to build cogent economic and political arguments that will influence policy and funding decisions.

The findings from this brief review of school feeding programmes are both encouraging and important because they show that the cognitive and school competence of disadvantaged schoolchildren in developing countries can benefit from health and nutrition interventions, even in the face of accumulated and continuous disadvantage from infections and socio-economic stresses. However, these multiple stresses together with the dearth of resources and basic amenities in many schools, strongly suggest that for investments to be maximised integrated interventions are needed to address poor achievement levels. Interventions need to include health, nutrition and education components as well as school meals.

One research group that has been working on such integrated health and nutrition programmes for the last 10 years is the Partnership for Child Development (PCD) led by researchers at Imperial College in London. One evaluation supported by PCD looked at the improved government mid-day meal programme in Gujarat, India. A standard meal programme had been implemented in Gujarat since the 1960, but in 1993 it was improved by the addition of a package of health inputs including de-worming medicine, iron, vitamin A, and iodine fortified salt. When it was evaluated three years later, the investigators found that the attitudes of government officials, teachers, students, parents and community members were predominantly positive towards the improved programme and the programme had been delivered efficiently. Moreover, on average, children who received supplements were as much as 1.1 kg heavier and 1.1 cm. taller than those who did not; blood iron (haemoglobin) levels were increased, intestinal parasite prevalence rates were halved and prevalence of night blindness and vitamin A deficiency were significantly reduced. Since 2003, the 'Gujarat Model' has been extended to three further states covering approximately 30 million school children (Gopaldas, 2005).

It is becoming increasingly popular to use school feeding programmes as a vehicle for micro-nutrient fortification. A survey conducted by the South African Medical Research Council (MRC) in primary school children from a rural area in KwaZulu-Natal found that even though a school meal programme had been in operation for two years, 40% of children were deficient in vitamin A, 28% were anaemic, 97% were iodine deficient and 21% presented with visible or palpable goitre. A subsequent intervention examined the feasibility of using school feeding as a vehicle for micronutrient fortification. Various food items, such as biscuits, bread spread, and soup, were evaluated as potential carriers for micronutrients with positive effects on micronutrient status, growth, morbidity and cognitive function. The investigators conclude that for schoolchildren to realize their full mental and physical potential and to perform optimally at school, both short-term hunger and hidden hunger

(micronutrient deficiencies) need to be addressed. They argue that school feeding offers a good opportunity to alleviate both of these hungers and should therefore be more fully utilized (van Stuijvenberg, 2005).

4.2.3 Iron deficiency

As mentioned in Chapter 1, over 200 million children suffer from iron deficiency anaemia resulting from poor diet and worm infestation. Iron deficiency anaemia (hereafter called anaemia) causes weakness, poor physical growth, and a compromised immune system, decreasing the ability to fight infections and increasing morbidity. Anaemia is also thought to impair cognitive performance and delay psychomotor development.

A large study by Hall et al. (2001) in rural schools in Ghana, Indonesia, Kenya, Malawi, Mali, Mozambique, Tanzania and Vietnam found anaemia was a severe public health problem (defined as more than 40% anaemic) in five African countries for children aged 7-11 years and in four of the same countries for children aged 12-14 years. Anaemia levels, although high, were below the 40% threshold to be defined as a public health problem in the children studied in the two Asian countries. Surprisingly, more boys than girls were anaemic. Children who enrolled late in school were more likely to be anaemic than children who enrolled closer to the correct age. The investigators concluded that anaemia was a significant problem in schoolchildren in sub-Saharan Africa (SSA). They argued that school-based health services which provide treatments for simple conditions that cause blood loss, such as worms, followed by multiple micronutrient supplements including iron, have the potential to provide relief from a large burden of anaemia (Hall et al., 2001).

Smaller studies have endorsed these findings. A cross-sectional study in rural Jamaica sought to determine whether nutritional status, anaemia and worm infections were related to school achievement and attendance in primary school children. Eight hundred children aged 9-13 years were randomly selected from those enrolled in grade 5 in 16 primary schools. 4.9% of the children were stunted, 14.7% were anaemic and 57.7% had worm infections. Despite these relative mild levels of undernutrition and worm infections multivariate analyses, controlled for socioeconomic status, indicated that children with worm infections had significantly lower achievement levels than uninfected children in spelling, reading, and arithmetic. Stunting was associated with poor performance in arithmetic. Worm infection and anaemia predicted poorer school attendance. The investigators concluded that although the associations demonstrated in this study were not necessarily causal they did indicate that efforts to increase school achievement levels in developing countries should include strategies to address the health and nutritional status of rural children (Hutchinson et al., 1997).

Recent macroeconomic estimates suggest that the impact of anaemia, through both physical and cognitive channels, could be as large as 4 % of GDP on average in less developed countries (Horton and Ross, 2003). Through its impact on school participation and learning, anemia could also be central to understanding the intergenerational transmission of poverty. Yet there is little work by economists on the effects of anemia on economic development, and many existing non-experimental studies exploring the impact of anemia, and other dimensions of poor nutrition, on

education are difficult to interpret due to the possibility of omitted variable bias (Bobonis et al., 2004).

4.2.4 Iodine deficiency

As mentioned in chapter 1, it is estimated that as many as 60 million school-age children suffer from iodine deficiency disorders worldwide. Most of these children live in the mountainous regions of developing countries and younger children are also affected.

It is well established that iodine deficiency in pregnancy leads to poor cognitive function in the offspring but the concurrent effects of iodine deficiency on school-aged children is not clear. Although several studies have shown that school children in iodine-deficient villages have poorer cognitive function than children in iodine-sufficient villages, the children's nutrition and health status has not usually been taken into account and the estimations may be confounded by environmental factors.

A study in Bangladesh compared the cognitive function and school achievement levels of 170 children who had recently been iodine deficient with children who were not deficient. The children were matched for school and grade level and came from the same iodine-deficient regions in rural Bangladesh. They measured nutritional status, tested stool samples for worm infestation, and assessed the home environment. They controlled for children's height and arm circumference, experience of hunger, parental characteristics and stimulation in the home. They found that the iodine deficient children performed worse than those who were not deficient on reading and spelling and on the general cognitive factor. They concluded that these findings indicate that a large number of disadvantages including iodine deficiency are related to the poor development of these children (Huda et al., 1999).

4.2.5 Vitamin A deficiency

The small number of studies conducted on vitamin A deficiency in school-age children developing countries suggest that it is a public health problem in this age group (with more than 30% of children deficient). The study in South Africa reported above found 40% of primary school children were vitamin A deficient. A review of studies in Bangladesh where 90% of under five year olds receive vitamin A supplementation has suggested that vitamin A deficiency may be a larger problem in school-age children than in pre-school children with deficiency levels higher in boys than girls. A study in Mexico found that almost half of school children surveyed were vitamin A deficient (Drake et al., 2000). As mentioned above fortifying school meals with vitamin A has the potential to address deficiencies alongside efforts to promote increased consumption of green, yellow and red fruits and vegetables and red palm oil.

4.3 Infectious diseases

4.3.1 Diarrhoea

Although children under five years of age are at greatest risk of mortality from diarrhea, it causes high levels of morbidity in school-age children and diarrhoea is a principal cause of school absenteeism. Poor water and sanitation provision in school

may damage the health and nutritional status of schoolchildren by exposing them to hazards such as diarrhoeal diseases and reduce girl's access to schooling. (It is also well recognized that lack of separate toilet and washing facilities for girls is a major barrier to girls' enrollment and attendance at school especially after mensis) (UNICEF/IRC, 2005).

But what is the impact of diarrhea on cognitive function? The literature search only found one study that has addressed this question. This study, by Tarleton (2006) assessed cognitive function in 191 Bangladeshi children 6-9 years of age using verbal and nonverbal tests. These scores were added to a health surveillance database that was compiled over the four previous years, which included incidence of diarrhoea and Entamoeba histolytica infection and nutritional status. The investigators analysed the associations of diarrhoea, malnutrition, and social factors with cognitive scores, and associations between diarrhoea and test scores were controlled for the influence of social factors. The findings showed that cognitive scores were negatively associated with stunting during school age, as well as the height-for-age and weight-for-age scores at study enrollment. The incidence of diarrhoea was associated with nonverbal test scores before, but not after, controlling for socioeconomic factors. Generally E. histolytica infection was not found to independently influence scores, except that E. histolytica-associated dysentery was associated with lower test scores while dysentery of any etiology was not. The investigates concluded that malnutrition leading to stunting during the school age years, but not diarrhoea or E. histolytica infection, was associated with a lower level of cognitive functioning. There is a need for further well designed studies to examine these associations in different contexts.

4.3.2 Worms

Worms thrive in communities in need of better housing, sanitation, clean water, education and increased personal earning. School-age children are the most heavily affected group for many worm infections, both in terms of prevalence and intensity. Indeed, intestinal worms are the largest single contributor to the total disease burden of 5-14 year olds worldwide and an estimated 150,000 children die each year from intestinal obstruction, and other abdominal complications, caused by large adult worms. (UNICEF 1998). About 40% of all school-age children are infested with worms and 88 million children under 15 years of age with schistosomiasis. Such disease burdens, especially between the ages of 5 and 14 years, a critical period for mental and physical, have a negative effect on growth, nutritional status, physical activities, cognition, concentration and school performance (UNICEF/IRC, 2005). Furthermore new, broad-spectrum, low-cost de-worming medicines safely, rapidly and inexpensively removes infection with positive benefits for physical state and development (Bundy and de Silva, 1998).

There is a substantial literature to support the widespread adoption of deworming programmes to improve educational outcomes. A questionnaire survey conducted in Zanzibar found that among non-enrolled school-age children, the proportion of heavy intensity infections was twice that of enrolled school-age children (Montresor et al., 2001). Another study in South Africa examined whipworms and other parasites in school-age children and found that deworrming medicine had some effect on cognitive and education outcomes, but some impacts were not statistically significant.

However, this study has been criticised for having a relatively small sample size of only 210 children (Kvalsig et al., 1991).

A study in Kenya, identified by Glewwe as being amongst the best randomised evaluations conducted in recent years, evaluated a project in which school-based mass treatment with inexpensive deworming drugs was randomly phased into schools, rather than to individuals, allowing estimation of overall program effects. The investigators found that the program improved child health and reduced school absenteeism by at least one-quarter in the first 2 years of the project and schooling increased by 0.14 years per pupil treated. These treatment gains were largest for the youngest children who suffered most ill-health. There were also clear externalities, with significant reductions in the worm burdens and increases in attendance rates amongst the 22% of children in treatment schools who did not receive deworming medicine, and untreated students and neighboring schools as a result of reduced disease transmission. The authors argue that these externalities are large enough to justify fully subsidizing treatment. They did not find evidence that deworming improved academic test scores which is surprising given the increased schooling.

This study also showed that deworming in schools was highly cost-effective as an education intervention to improve attendance. It offered a high rate of return, increasing the net present value of discounted wages by more than $30 per treated child compared with per treatment costs of under $1. They concluded that these benefits still outweigh the costs even if increased school participation leads to greater costs through the need for additional teachers. They noted that the benefit-cost ration remains more than 10 if the rate of return to an additional year of schooling is as low as 1.5% (Miguel and Kremer, 2004).

A very recent study in rural Tanzania took a rather different approach. It investigated whether the impact of treating infected children with deworming medicine is registered more clearly when dynamic rather than static testing is used. Previous studies had used static testing, whereby the examiner was impartial, administered the test and did not reveal the answers to the children so that their developed competencies were being measured. In this study, dynamic testing was also used, whereby the children were specifically instructed as part of the assessment and encouraged to view the assessment as a learning opportunity as well as a chance to display previously acquired skills.

At the start of the study over 300 children were assessed for the presence/absence and worms and assigned to one of three groups -infected/treated with worm medicine, infected/not treated, and uninfected/not treated. All three groups were assessed with dynamically administered cognitive tests on three separate occasions with each session including pretest, instruction, and posttest, conventionally (statically) administered cognitive tests, and traditionally administered educational achievement tests. The data demonstrated that the children who were treated for worms and those who were not infected with worms showed higher cognitive gains on two out of three dynamically administered tasks and one out of eight statically administered tasks than did the children who were infected but not treated. The investigators concluded that deworming medicine appears to contribute to improvement in cognitive functioning and that this improvement is captured more clearly in dynamic rather than in static tasks. However, they argue that the pathways of this improvement are still not understood and require further investigation (Grigorenko et al., Submitted).

An innovative study in Kenya in 1994, which used motion detectors on the thighs of school children, found that ridding the youngsters of high levels of hookworm improved physical activity. Dewormed children reported better appetites and an end to abdominal pains and headaches. Within nine weeks, the treated group showed better growth, weight gain (both in terms of fat deposits and muscle mass), physical activity and appetite than the untreated group. Numerous studies have also noted the mental and cognitive effects of anaemia in children infected with worms, with intellectual performance improving after treatment (UNICEF, 1998).

Jukes et al. (2002) point out that treatment trials alone cannot give a complete picture of the cognitive impairments cased by worm infections because infection may cause irreversible damage to cognitive function. Although, ideally, randomised controlled trials of primary prevention of infection are needed to clarify this issue, such trials could be unethical and there is no record in the literature that any have been conducted. One study in 10 schools on the coastal area in Tanzania tried to address these issues using a combination of cross-sectional methodology and a treatment trial. Children aged 9-14 years were assessed for their level of worm infection and given cognitive and educational tests. A novel reading test was developed as part of this study, and all other tests used had been adapted and chosen because they measured a range of abilities and had been shown in other studies to be sensitive to the effects of hunger, undernutrition, chronic illnesses or worm infection. Children were given a snack and drink before being tested to make sure they were not hungry.

Measurements were also taken of an extensive range of potentially confounding or mediating factors such as socioeconomic and educational factors, anthropometric and other biomedical measures. (For example, children's date of birth was taken from the school register and from medical clinic cards and they were given a structured individual interview at school to find out about their home environment and their educational opportunities)

Multiple regression analyses, controlling for all confounding and mediating variables, revealed that children with a heavy Shistosoma haematobium infection had significantly lower scores than uninfected children on two tests of verbal short-term memory and two reaction time tasks. In one of these tests the effect was greatest for children with poor nutritional status. There was no association between infection and educational achievement, nor between moderate infection with either species of worm and performance on the cognitive tests. The investigators conclude that this study provides strong evidence that S. haematobium is associated with impaired mental performance and that children with heavy worm burdens and poor nutritional status are most likely to suffer cognitive impairment, and the domains of verbal short-term memory and speed of information processing are those most likely to be affected. They call for more studies to help clarify the mechanism through which worm infection leads to impaired learning by paying attention to identifying the types of cognitive and educational tests affected and not just the number of tests. They hypothesize that children with heavy worm loads suffer from lassitude and show poor sustained attention and note that previous studies have failed to measure children's attention span directly. They suggest that this hypothesis presents an interesting avenue for future research

Although more work needs to be done, the clear message coming out of the evidence base is that deworming is simple and relatively inexpensive and the educational

benefits are impressive. This message is being promoted by UNICEF, WHO and the World Bank who have identified pre-school and school-age children, women of childbearing age and adolescent girls as those who would benefit most from worm control programmes.

4.5 Whole school approaches to health

Rapid advances in strengthening the evidence base to demonstrate that health and nutritional status have a significant impact on educational access and achievement and that low-cost interventions can improve education access and achievement a have led to two major initiatives. The first is the WHO Global School Health Initiative (WHO, 1995), which is designed to improve the health of students, school personnel, families and other members of the community through schools through mobilising and strengthening health promotion and education activities at the local, national, regional and global levels. The second is the joint agency FRESH approach to school health launched at the World Education Forum in Dakar (WHO et al., 2000) as outlined in section 4.2.1. This approach was viewed as a fresh start to enhancing the quality and equity of education.

These initiatives promote a whole school approach to promote health and support educational outcomes. A whole school approach to health includes 4 main components: (i) promoting children's nutrition (through ensuring health food and snacks are consumed in school and that vulnerable children receive a meal with micronutrient supplementation where needed (ii) ensuring a safe emotional and physical environment, including absence of violence (ii) provision of clean water and safe disposal of faeces and deworming medicine where needed (iv) health education that uses a rights-based approach and develops life-skills as well as knowledge and understanding (v) a participatory and democratic school management style that support school health policies and strong school-community links. (iii) access to health services and products. Within these global initiatives an innovative approach to health education known as Child-to-Child has been widely adopted to enhance children's active participation in promoting their own health and wellbeing and that of their family and community (Pridmore and Stephens, 1999).

4.6 Summary

This review of the research evidence on the effects of poor health and nutrition in the primary and secondary school years poor health has highlighted the enormous advances made in the past decade in understanding the associations and how best to intervened to support education access and attainment. There is good evidence in the literature to suggest that school-aged children who suffer from protein-energy malnutrition, hunger, or who lack certain micronutrients in their diet (particularly iron, iodine or vitamin A), do not have the same potential for learning as healthy and well-nourished children and that they are more likely to repeat grades, drop out early and fail to learn adequately due to poor attention, low motivation and poor cognitive function.

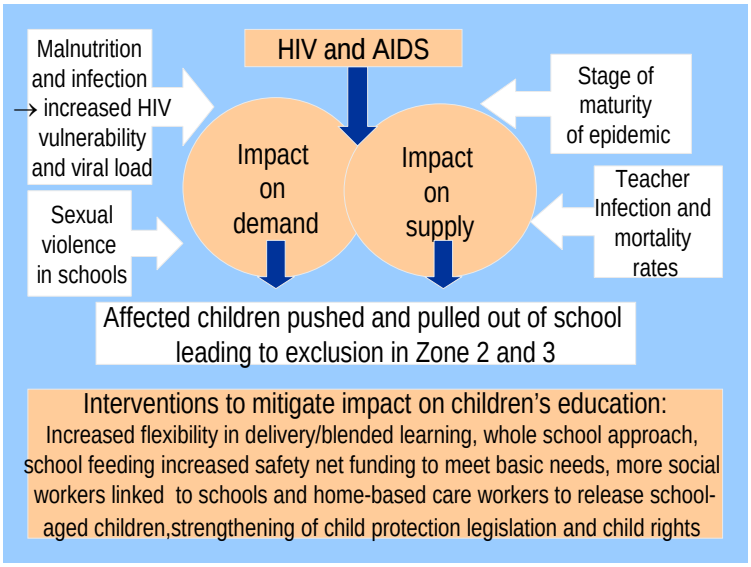
The review has also revealed gaps it the literature and identified key areas for future research. Some of the research questions that need to be addressed are listed below:

- How can nutrition interventions be better targeted toward school-age children

  - What role can FFE play as an incentive for participation in education?
  - What are the effects of age and nutrition status of the children, the quality of the school, and the timing of the meal on the outcomes from school meal programmes? (Grantham-McGregor 2005 argues for long-term randomized controlled trials of giving school meals in poor countries
  - What are the special needs of orphans and how can they be addressed through school feeding programmes?
- What are the long-term financial and social benefits of school feeding programmes?
- What are the mechanisms through which poor health and nutrition are translated into poor education outcomes? (Glewwe (2005) argues for further analyses of longitudinal data)
- What are the likely biases in non-experimental designs? (Glewwe (2005) argues for more randomised evaluations, which compare their findings with standard cross-sectional or longitudinal estimates based on the control group data)
- What are the mechanisms through which worm infection leads to impaired learning?
  - What types of learning are most impaired by worm infections?
  - Is lassitude and low attention span associated with worm infections and poor cognition?

5. HIV and AIDS

Figure 5 Conceptual framework for section 5



This section reviews the research evidence for the impact of HIV and AIDS on access to education and attainment for boys and for girls, across all 4 Zones of the CREATE Access model. It identifies both push and pull factors that shape the actions of affected communities, households, parents, learners and schools, and which lead to crossing the threshold into exclusion.

There are four groups of school-aged children whose lives are most directly affected by HIV and AIDS and whose access to education is therefore potentially at greatest risk. These are children who are themselves infected, children living in households where there are sick family members, children whose parents or guardians have died of AIDS and children living in households which have considerably expanded in size due to adoption or fostering of children orphaned by AIDS.

Ensuring that these vulnerable children are enrolled and stay in school is crucial role for combating the HIV epidemic because it is now recognised that education can act as a 'social vaccine' helping to reduce the rate of spread of the virus. The 'Social vaccine' is seen to work through the HIV/AIDS and sexual health information received at school and through basic education, which can empower girls with the knowledge, confidence and skills needed to stand up for their own beliefs and thereby practice safer sexual behaviours and act as an antidote to the silence, shame, stigma and superstition about HIV/AIDS that thrives as a result of illiteracy (Pridmore and Yates, 2005). In a review of the evidence for the relationship between schooling and HIV prevalence, Jukes and Desai (2005) cite one analysis based on data from Uganda which suggests that universal primary education could save 700,000 young adults from HIV infection. The authors also cite evidence from Tanzania to suggest that a 1% increase in female primary school enrolment would be responsible for a 0.15% reduction in HIV prevalence in this group. In this case investment in expanded school enrolment for girls is cost effective purely in terms of the effect it will have through

averted cases of HIV and the earning potential of these individuals, with a cost-benefit ratio of between 1.3 and 2.9. They conclude that there is a strong case for making expanded primary education and improved literacy a central part of the global response to the HIV/AIDS epidemic.

The discussion in this section is organised into two main sections. The first part reviews evidence on the impact of HIV and AIDS on education access and attainment and addresses issue of both demand for and supply of education. The second section reviews literature on interventions to mitigate the education impact of HIV and AIDS on school-aged children. The section concludes with some comments on the implications for teacher education.

5.1 Impact on education access and attainment

The HIV epidemic is spreading rapidly amongst young people aged 15-24 yrs who now make up one quarter of the 38 million people living with HIV. In 2003, more than half of the 5 million new infections were in young people under the age of 25yrs and the majority of these new infections were amongst young women who mostly because of gender disparities bear a disproportionate share of the HIV/AIDS burden (UNICEF, 2004).

By 2003, 15 million children under 18 years had already been orphaned by HIV/AIDS worldwide. About 12 million of these live in sub-Saharan Africa with an estimated 1,200,000 in South Africa and 170,000 in Ghana (UNAIDS, 2006). In South Africa, it is predicted that 30% of under 15 year olds will be orphaned by 2010 (Hunter and Williamson, 2000). The HIV epidemic shows little sign of slowing down in SSA and there is a group of 7 high prevalence countries where the percentage of orphans (from all causes) is projected to increase very significantly over the next decade. These countries are Botswana, Central African Republic, Lesotho, Mozambique, Namibia, South Africa, Swaziland and Zimbabwe) (UNAIDS, 2004). Most of the AIDS orphans who live outside of Africa live in Asia, where the total number of children orphaned for all reasons exceeds 87 million (UNESCO 2005). There are insufficient data available from Asia to give figures on children orphaned by AIDS for individual countries (UNAIDS, 2006) but the HIV epidemic is gathering momentum in most of Asia (and also Eastern Europe). These figures are tragic. But what do they mean for education access and achievement of the school-age children directly affected by HIV and AIDS?

Bennell (2005b) notes that information on the numbers of children directly affected by the epidemic is very limited in most countries in SSA. Detailed surveys have rarely been undertaken and estimates of the sizes of these three groups vary considerably for any one country. Problems arise because it is often difficult to establish whether a child, parent or carer is ill with or has died as a result of an AIDS-related illness and because there is no standard definition of an orphan. Schools rarely keep accurate records, even on the parental status of children. He cites research to show that HIV prevalence among the surviving parent of (one-parent) orphans is 4-5 times higher than among the parents of non-orphans and therefore the probability that orphans will have a sick parent is much greater than other children.

5.1.1 Impact on demand

Children who are themselves infected with HIV, are only a small proportion of the millions who are affected. In the absence of inexpensive anti-retroviral drugs to prevent mother-to-child transmission about 30% of infants become infected with HIV in utero or through breastfeeding. The vast majority (about 90%) of these children fail to thrive and die before they reach school-age thereby contributing to educational exclusion in Zone 1. In the absence of anti-retroviral treatment (ART) those who do survive will have reduced attendance and increased drop out as they become progressively ill with AIDS-related health problems. Consequently, very few primary school-aged children are currently infected. During the secondary school-age years, however, young people are becoming sexually active and in high prevalence countries such as Botswana about 0.24% of 15-19 year olds are infected. This figure is projected to remain constant between 2000 and 2010 in which case the AIDS-related deaths among students in secondary school in Botswana will increase by around 25% from 435 in 1999 to 558 in 2009 (Bennell, 2005b p.483).

Children who are not infected at birth but live in disadvantaged communities where they are challenged by malnutrition, burdened with parasites and infectious diseases, and lacking access to medical care will have increased vulnerability to HIV infection. A scholarly publication by Stillwater (2006) reports evidence from research studies to shown that activation of the body's immune system caused by endemic infections, particularly worm infections such as schistosomiasis, increases susceptibility to HIV infection. This evidence is a cause of particular concern in school-aged children given the very high prevalence of worm infections in this age group, and it has lead to calls for aggressive treatment and control programmes for worm infections in areas of Africa, India and Southeast Asia where the HIV epidemic is rampant (Stillwater, 2006 p.53). Furthermore, malnutrition, the presence of sexually transmitted infections, malaria, tuberculosis and other diseases increase vulnerability to HIV replication following infection leading to increased viral load and transmission of the virus (Stillwater, 2006 p.213). Stillwater points out that although the environment of poverty is complex the solutions are rather simple in that we know what investments to reduce the disease burden from malnutrition and infectious diseases are needed to achieve the MDGs and help eradicate poverty. She concludes that given current levels of funding to combat HIV it is a scandal that so much human suffering results from the failure to allocate resources to these human needs and to challenge oppressive systems (Stillwater, 2006 p.219).

Children who are affected rather than infected by HIV and AIDS are likely to be impacted by increased family demands for child labour, which may pull them out of school:

> Children are frequently removed from school to take care of failing family members, or forced to work in order to bring extra income into the household. Children whose family embers are sick or dying are traumatized. They may often be left alone with their grief because of the isolation and stigma that can accompany HIV/AIDS (UNAIDS, 2006: 2).

To support this statement UNAIDS (2006) present recent Demographic and Health Survey (DHS) data from 31 countries in SSA showing that children aged 10-14 years

who have lost both their parents are less likely to be in school that their peers who are living with only one parent.

Findings from a study by (Bicego et al., 2003) also support this view. The investigators used recent Demographic and Health Survey (DHS) data from Zimbabwe, Kenya, Tanzania, Ghana, and Niger to evaluate the vulnerability of orphans to educational opportunities in relation to non-orphans' experience. The results of the multivariate analysis indicate that losing one or both parents is significantly associated with diminished chances of being at the appropriate grade level for age. The results of the study indicate that orphans are less likely than non-orphans to be at their proper educational level, with the effect stronger at younger ages (age 6–10) than older ages (11–14). Loss of both parents places a child at particular disadvantage, and loss of a mother appears more detrimental than loss of a father with regard to educational attainment. It is ironical that orphans should be more frequently deprived of education when it is the very thing they need to help protect themselves from HIV.

By contrast, Bennell (2005b) argues that there is little robust empirical research to confirm the link between HIV/AIDS and reduced demand for primary and secondary schooling. He notes that a number of country impact assessments have now been completed but nearly all of these rely heavily on demographic models to make projections of student enrolments and teacher requirements. He also notes that a number of more qualitative factors have also been identified that are likely to affect both supply of and demand for schooling but they have not been analysed in detail with adequate supporting evidence. In particular, very little systematic research has been successfully undertaken in schools themselves.

Bennell (2005b) draws on data from school surveys in Uganda, Malawi and Botswana to illuminate some of the complexities surrounding the impact of HIV/AIDS on schooling. These school surveys found that the relationship between parental status and school attendance is very complex and country specific. In Botswana orphans attended school even more regularly than non-orphans (but school attendance rates for all children are very high). In Malawi and Uganda, where overall attendance rates are low, only female paternal and two-parent orphans had significantly (i.e. more than 20%) higher absenteeism rates than non-orphans. In all three countries over half of all the absences from school were due to children being ill, which is of particular concern in Malawi and Uganda where absenteeism rates are very high, but there was no evidence to suggest that orphans are ill more often than non orphans.

These three surveys provide additional insight into how closely contextualised the impact of HIV is on children's education. In Malawi the death of a mother appeared to lead to an appreciable increase in household demand for female child labour whereas in Uganda it was the loss of the father that increased the demand for child labour. Illness in the family was only a major reason for absenteeism in two-parent orphans in Uganda. In focus group discussions in Malawi orphans indicated that lack of appropriate clothing and money to buy detergent for washing clothes, as well as food and other basic need were main reasons why they miss school. Repetition rates in Botswana were higher among maternal orphans, in Malawi they were higher amongst male orphans and only slightly higher among female paternal and maternal orphans and in Uganda they were again lower for maternal and two-parent orphans

but higher among paternal orphans. In all three countries all orphans, and two parent orphans in particular, were more likely to interrupt their schooling than non-orphans.

In a study by Pridmore and Yates (2005) in Mozambique and South Africa school-aged children affected by HIV/AIDS were interviewed and data collected on their life stories through involving them in participatory activities. Agency staff supporting these young people were also interviewed. Reasons for dropping out of school given by these young people were peer pressure, lack of money (for school materials and registration and monthly fees) and the need to earn a living, being excluded for indiscipline and fighting, missing lessons, sickness and death of parents and being treated harshly by teachers. In some cases schools appeared to want to divorce themselves from the children's outside lives and teachers were reported to have remonstrated with affected children in front of their classmates for being late or absent or having poor concentration in class. Other studies have shown that affected children face stigma and discrimination in school, both from teachers and their peers (Ishikawa, forthcoming).

An unhealthy and unsafe school environment has also been found to reduce the demand for education from girls. It is a common cause of absenteeism and school drop out in some countries and carries a serious risk of HIV infection in high prevalence countries. Where schools promote stereotypical masculine and feminine behaviours and inequalities in the classroom, the different expectations of behaviour of girls and of boys can lead to strong pressures to conform and to many different forms of gender violence. One study in South Africa, in Kwa-Zulu Natal, Gauteng and the Western Cape, found that sexual harassment of girls by both teachers and other students was common in many schools. Girls aged 7-17 years reported being raped in school lavatories, dormitories, and empty classrooms. One girls said "I left [school] because I was raped by two guys in my class who were supposedly my friends" and another commented "I didn't go back to school for one month after I came forward. Everything reminds me, wearing my school uniform reminds me of what happened. I have dreams. He [the teacher] is in my dreams" (Human rights watch, 2001, summary). A study in junior secondary schools in Dodowa, Ghana, found that teachers were responsible for 5% of sexual assaults on female students and one third of the 50 teachers interviewed said they knew of at least one teacher who had sex with students (Afenyadu and Goparaju, 2003).

Leach (2004) examines the prevalence of gender-based violence in African schools drawing on a number of studies that endorse the above findings. She concludes that there is contradiction between the school as a location for high-risk sexual practice and the school as a forum for teaching and encouraging safe sex. She advocates for 'breaking the silence' around school-based abuse and greater level of responsibility at the Ministry level for tackling harassment and abuse in schools. She argues that at school level there needs to be increased efforts to replace authoritarian school cultures by a more open and democratic one in which pupils, teachers and parents can discuss sexuality issues openly together. To achieve these changes schools need to work both through the curriculum and through school management and discipline to encourage collaborative relationships between pupils and to punish teachers and pupils who engage in abusive and violent behaviour.

Another major cause of school drop out worldwide is teenage pregnancy. UNICEF (2006) draws attention to reports from East Africa that girls orphaned by AIDS are

increasingly being steered towards early marriage by their caregivers who find it hard to provide for them. This is a cause for concern because it can lead to exclusion in Zones 2 and 3. It is also a cause for concern because pregnancy-related deaths are the leading cause of mortality for 15 to 19 year old girls worldwide. Those under 15 years are five times more likely to die than women in their twenties (UNICEF, 2006).

5.1.2 Impact on supply

There is a general consensus that HIV and AIDS affects the supply of primary and secondary schooling:

> In countries hard hit by HIV/AIDS school availability has fallen precipitously. Substantial numbers of teachers are ill, dying or caring for family members. The quality of education has also dropped in many regions. The illness and death of qualified personnel threaten management of the education system. Rural schools often lose staff because teachers flock to urban areas so that they or their family members can be closer to hospitals (UNAIDS, 2006 .7).

However, the question of whether teachers are or are not a high risk group for HIV has been the subject of an ongoing debate. Three investigators have reviewed the evidence and come to different conclusions. Although their arguments are highly qualified and nuanced, Kelly (2000) contends that teacher infection rates in SSA are very high, Bennell (2005a) contends that teachers' infection rates are no higher than other people and Carr-Hill (2002) contends that teachers are dropping out slower than pupils:

> Actual HIV testing of teachers and office workers in the early 1990s found that the levels of infection were strikingly high relative to other groups. Seven years later the almost inevitable outcomes of this finding materialized: teacher mortality in Zambia stood at 39 per thousand, being about 70% higher than the general population (Kelly, 2000a . 64).
>
> Teacher mortality rates are generally much lower than those for the adult population as a whole (Bennell, 2003 .18).
>
> …there is no obvious impact of the death of teachers on the pupil-teacher ration; students are either dying or abstaining as fast or faster (Carr-Hill et al., 2002 . 164).

In the latest of these reviews, Bennell (2005a), presents recent evidence from high HIV prevalence countries in eastern, central and southern Africa that suggests teacher mortality rates are considerably lower than those for the adult population as a whole. He points out that while demographic projections show AIDS-related mortality for teachers increasing very sharply during the next 5-10 years, teacher mortality rates are in fact declining in a number of high prevalence countries mainly as a result of behaviour change and the increasing availability of anti-retroviral drugs. Bennell and Akyeampong (2006) report that even in Swaziland, which has an estimated national HIV prevalence of over 40%, only one % of teachers died from all causes in 2004.

What we need to remember here is that in SSA there is not one HIV epidemic but many epidemics all at different stages of maturity. Further insight into the complexities and ramifications of these stages are provided by Jukes and Desai

(2005). These investigators review the evidence for an association between levels of education and HIV prevalence in different countries. They conclude that although a higher level of education is associated with higher HIV prevalence in the early stages of an epidemic, in the later stages more educated individuals have less risky behaviour and are less likely to be HIV positive. They note that this is true in many settings but it is particularly evident in Uganda, where a national prevention campaign has successfully reduced HIV prevalence.

Education supply is also affected by teacher motivation. There is growing concern in the literature that teachers are becoming increasingly de-motivated and that this is reflected in deteriorating teacher performance and learning outcomes. The close association between HIV prevalence and disadvantage in countries with mature epidemics means that teachers in high prevalence areas are more likely to be adversely affected through living and working in especially difficult circumstances with high levels of stress and inadequate support from school managers. A report by Bennell and Akyeampong (2006) synthesized the findings from 12 country studies in sub-Saharan Africa and south Asia and found that sizeable proportions of school teachers in Lesotho and Zambia and to a lesser extent in Tanzania did not agree with the general statement that 'the impact of HIV/AIDS has not been serious at this school'.

5.2 Interventions to mitigate impact

There is a rapidly growing literature on interventions to help mitigate the impact of HIV and AIDS on school-aged children who are directly affected by the epidemic, but a dearth of evaluation data.

At the international level it is well recognized that food is the greatest need for many families affected by HIV (World Food Programme, 2003). Consequently, school feeding programmes and FFE programmes in particular are being promoted by the international agencies to help mitigate against HIV/AIDS "School feeding programmes can relieve the burden on HIV-affected families and free girls to pursue their education" (UNICEF, 2004, .20). Providing a free school meal can effectively boost both nutrition and attendance.

At the country level the impact of AIDS on education systems will depend to a large extent on how much support governments are willing and able to provide to orphans and other children made vulnerable children by the epidemic. Bennell (2005b) found that in the three countries for which there are school survey data (Uganda, Botswana, Malawi), schools have provided very little support for these children. He lists the problems: failure of Ministries of Education to develop comprehensive and coherent policy frameworks; negative attitudes of school managers and teachers concerning what schools should do to support orphans and other disadvantaged children; chronic and pervasive resource constraints (except in Botswana and South Africa); the generally unsupportive school environment with only a minority of schools being child-friendly; the absence of serious overt discrimination against children directly affected by the epidemic. These findings are endorsed by a cross-country review of government action to combat AIDS which found that no action had been taken in 17 out of the 18 countries surveyed to prevent potential impact of teacher shortages or meet the educational needs of orphans and HIV positive children. Furthermore, donor aid was not helping government to address these problems more systematically.

Rather aid tended to be directed towards a series of stand-alone initiates that enjoyed little ownership by government (Boler and Jellema, 2005).

Bennell (2005b) argues that in the countries where 30-40% of all children are projected to be orphans by 2010 there are a set of conditions that will need to be met if affected children's access to education is not to be severely reduced. These conditions are: greatly increased safety net funding to meet the basic needs of these children, greatly increased numbers of social workers to work with schools; increased emphasis on children's rights and strengthening of child protection legislation; increased home-based care and other material support for the terminally ill. School managers and teachers will also need to be more pro-active in identifying affected and needy children, referral and monitoring, school feeding, pastoral care and counseling, financial assistance with fees and other school-related expenses, involvement of guardians and caregivers, and support for children who are themselves infected.

A study by Pridmore and Yates (2005) in Mozambique and South Africa takes a very different approach to meeting educational needs. This study explored the potential for open, distance and flexible learning (ODFL) to mitigate the impact of HIV and AIDS on school-age children. The investigators found that in heavily infected communities schools are strongly challenged to meet the emotional as well as the educational needs of affected children and increasingly impoverished communities are reaching the limits of their capacity to meet the children's basic nutritional and emotional needs. The authors select relevant experiences from around the world to illustrate more flexible models of educational provision that have been tried and tested and could be adapted for use in high HIV prevalence areas. In particular, they present suggestions for ways that ODFL could support and extend the work of existing infrastructures at the national level, community/school level, and individual/family/household level. The authors argue that the challenges to education posed by HIV/AIDS can provide a springboard from which to transform outdated education systems for the better and to deliver education more flexibly using a mixture of face-to-face and ODFL approaches.

An earlier call for radical transformation of education systems to respond to the challenges of HIV and AIDS was made by Kelly (2000b .103) who lists some of the changes needed: greater flexibility; increased resourcefulness and openness to change; tolerance for a diversity of solutions and models; willingness to loosen up bureaucratic constraints and procedures; co-operation and collaboration with several partners; meaningful decentralization based upon school autonomy and effective participation of local stakeholders; more involvement of people living with HIV and AIDS, community members and students; enhanced understanding of what education is all about; and sensitivity to the needs of those infected and affected by HIV, the poor and those in difficult circumstances.

Some of these suggestions are picked up by Hepburn (2004) who identifies a number of obstacles to education access and attainment in areas that are heavily affected by HIV and AIDS and makes suggestions for meeting the challenges. Obstacles include: lack of affordable schooling; increased familial responsibilities; family skepticism regarding the value of primary education; poor educational quality; and stigma and trauma, fear of infection. Suggested changes include: revising the role and content of the curriculum to focus on life skills, increased flexibility in the school calendar and

curriculum; and cost-effective community based initiatives to increase school participation.

In revising school curricula to include HIV prevention education it is important to draw on models of good practice that have come out of recent international developments in HIV/AIDS education. These models recognise the importance of the active involvement of young people in programme design and implementation, and the need for an accurate identification of the groups to be served and for gaining a deep understanding of their cultural values and circumstances. These models highlight the importance of addressing contextual factors that increase vulnerability to HIV infection though damaging self-esteem, eliminating choices and making it hard for individuals to stand up for themselves. Such factors include social inequality, social exclusion, sexism, racism and homophobia. To increase the chances of success, HIV prevention education must therefore take account of the local context and be located firmly within a rights-based approach (Pridmore and Yates, 2005).

5.3 Concluding comments

At a national level there is a strong case for governments making expanded primary education and improved literacy a central part of the global response to the HIV/AIDS epidemic and for increased efforts to combat sexual violence in schools.

At a local level there is real lack of basic data on the way that HIV and AIDS is impacting on education access and achievement of boys and girls at different ages and in different contexts, and on how the impact changes over time after the loss of a parent. A first step in bridging this gap is for all schools to do a simple needs assessment of each vulnerable child and then to keep accurate records to monitor his or her progress through the school, including dropout. There is a need for improved teacher training and support. Given the psychological stress that HIV and AIDS causes affected children all teachers will need to be trained to provide emotional support. In addition, there is a need for a new cadre of teachers who are professionally trained in support and guidance and who can work closely social workers and take overall responsibility with school managers for supporting needy children.

But if schools are really going to change to meet the educational needs of children made vulnerable by HIV and AIDS they will need to ‘look and feel different’. New models are already being tried and tested in SSA and elsewhere that develop schools as multipurpose centers for education and health linked to community based ‘circles of support’ around each vulnerable child. There is great potential here for the development of blended learning using a mixture of face-to-face and distance learning, which will require the development of more flexible learning materials and patterns of delivery. Given the high levels of poverty in many communities heavily affected by HIV and the way in which the disease can make families destitute, it is crucial that basic education is free and that vulnerable children are targeted for assistance with all other essential schooling costs.

6. Implications for Education Practice and Future Research

This chapter summarises the main findings from the literature review and draws out further implications for the conceptual development of the Zones of Access model and for the design of future empirical studies.

6.1 Synthesis of main findings

This literature review has shown that a body of evidence is now available to link health and nutritional status to educational enrolment and achievement in developing countries. Furthermore, there is some consensus amongst the international development agencies that the evidence base is now sufficiently strong to allow for responsible interventions and policymaking (Bundy, 2005; Pollitt, 2005). This consensus has led to remarkable progress being made in the past 5 years in implementation of school health and nutrition policies and programmes and in understanding of the effects of these programmes (Pollitt, 2005).

Evaluation studies have shown that, overall, the evidence for a programmatic impact on education is good for achievement, reasonable for attendance and poor for enrolment. However, researchers have also identified that problems in study design are common and that the evidence base is not yet complete to meet the stringent criteria of established knowledge. The gaps identified in the literature signal a number of specific issues that have not been addressed well enough. Research questions related to these gaps are listed below.

Study design:

What are the likely biases in non-experimental designs? (Glewwe (2005) argues for more randomised evaluations, which compare their findings with standard cross-sectional or longitudinal estimates based on the control group data)

Long term effects of poor health and nutrition in early childhood on children in Zones 1, 2 and 3:

- To what extent does mild to moderate anaemia affects children's development and education access and outcomes?
- What is the role of health and nutrition programmes in improving education access, through preventing disability or correcting eye vision problems?
- What are the independent cumulative effects of poverty, poor health and malnutrition on intellectual development and education through the generally recognized developmental periods, across a variety of eco-cultural settings?

Effects of poor health and nutrition on primary and secondary school age children (in Zones 2 and 3):

- How can nutrition interventions be better targeted toward school-age children
    - What role can FFE play as an incentive for participation in education?
    - What are the effects of age and nutrition status of the children, the quality of the school, and the timing of the meal on the outcomes from school meal

programmes? (Grantham-McGregor (2005) argues for long-term randomized controlled trials of giving school meals in poor countries
    - What are the special needs of orphans and how can they be addressed through school feeding programmes?
    - What are the long-term financial and social benefits of school feeding programmes?
    - What is the efficacy of large-scale nutrition programmes in improving the nutritional status of school-aged children?
- What are the mechanisms through which poor health and nutrition are translated into poor education outcomes? (Glewwe (2005) argues for further analyses of longitudinal data)
- Does malaria prevention improve school attendance?
- What are the mechanisms through which worm infection leads to impaired learning?
    - What types of learning are most impaired by worm infections?
    - Is lassitude and low attention span associated with worm infections and poor cognition?
- How is HIV and AIDS impacting on education access and achievement of boys and girls of different ages and how does the impact change over time after the loss of a parent.

6.2 Implications for the conceptual development of the CREATE access research framework

This review shows that under conditions of endemic poverty many children in developing countries are impacted by poor health and malnutrition from conception through infancy and the preschool years. These children acquired an initial disadvantage that is cumulative and continues through primary school unless intervention is made. Children are most vulnerable in the first two years of life and the major causes of death in small children are acute respiratory tract infection, diarrhoeal diseases, severe malnutrition, contagious childhood diseases such as measles and mother-to-child transmission of HIV. Major health shocks leading to exclusion in Zone 1 are brain damage caused by severe malaria and iodine deficiency cretinism. Less severe shocks leading to stunting and other developmental delays can result in delayed enrolment. These shocks come from mild and moderate undernutrition and micronutrient deficiency (especially iron, iodine and vitamin A) from poor diets, worm infestations from poor provision of clean water and sanitation, poor growth due to repeated episodes of diarrhoea and poor eyesight due to vitamin A deficiency. There is good evidence to show that interventions can remedy these problems and reasonable evidence to show that this can prevent long-term impacts on educational outcomes.

This review also shows that primary and secondary school-aged children are frequently subjected to health and nutritional shocks that can reduce educational access and achievement and lead to children being excluded in Zones 2, and 3. Under conditions of endemic poverty the main risks to primary school-aged children are similar to those in early childhood except that levels of worm infestation are higher in this age group. There is also good evidence to show that interventions can help save at risk children from dropping out. During the late primary and secondary years girls (and to a lesser extent boys) are additionally at risk of school-based violence, of HIV

infection in high prevalence countries. School feeding and micronutrient supplementation is being widely promoted, deworming programmes and comprehensive school health education programmes are now part of the international agenda to reach EFA. But there is still much more to be done to consolidate the evidence base and to ensure that children's needs are being met especially in disadvantaged and marginalized communities.

So how can the CREATE Access Model be expanded to reflected the way in which health and nutrition impacts education access and outcomes? A first step would be to add a column to the left of the existing graph to enable Zone 1 to be more fully addressed. This column would show how health shocks contribute to educational exclusion from birth (or even conception) to the age of school enrolment. Estimates are available for the numbers of children affected by health shocks in the early years that may allow for the graph to be extended backwards. It may also be possible to reflect the effects of health shocks that lead to children being in Zones 2 and 3 using some estimates of the numbers of children affected. Would it also be possible to reflect tried and tested interventions such as school feeding and deworming programmes that are being widely implemented to combat the health shocks and even the well-established Global School Health Programme and the FRESH approach that are part of a whole school approaches to health and educational access and achievement?

6.3 Implications for the design of future empirical studies

The clear message coming out of the literature is that more randomised controlled clinical treatment trials are needed to further unravel the complex chain of causality between poor health and nutrition and poor education access and achievement, and firmly establish the evidence base. Such studies are difficult to design and implement, they need high levels of funding and a long time frame. Such studies are beyond the scope of the CREATE work programme.

Given the strength of existing data to support nutrition and health interventions in both pre-school, primary school and junior secondary school the consensus amongst international agencies is that enough is already known to support spending on whole school approaches to health and educational outcomes as detailed above. Such approaches would include interventions such as deworming, school feeding and micronutrient supplementation as needed.

An avenue that could usefully be further investigated by CREATE through empirical educational studies would be to address the following three research questions.

1. What, if any, school health and nutrition policies and programmes are already in place to support education access and attainment in pre-school and school-age children?
2. What are the health and nutrition barriers to accessing conventional schooling for pre-school, primary and secondary school age children?
3. What more can schools and the communities they serve do to help overcome these barriers?

To address the first question analyses of secondary data would be made from policy and strategy documents, agency reports and academic critiques and primary data from semi-structured interviews and informal discussions with key informants including policy makers and administrators in the Ministries of Education and Health, international and bilateral development agencies and NGOs in each country.

To address the second question detailed case studies could be developed (i) to describe how children are being impacted by health and nutritional shocks and (ii) where the barriers to addressing these shocks are at the household level and at the school level. To capture health and nutrition threats from birth to school enrolment a household survey would need to be conducted. To capture the threats during the school-age years and to find out how schools are managing these threats a school-based survey would need to be conducted.

Questions related to health and cognition that could be included in a household survey in the CREATE countries are presented in Appendix 2. This appendix also includes two questions that require body measurements to be taken (height and middle upper arm circumference). Questions that could be included in a school-based survey are presented in Appendix 3.

In developing these survey questions a range of questionnaires that have been used by other researchers in this field were firstly reviewed and reference was made to a handbook on designing household survey questionnaires for developing countries published by the World Bank (see Grosh and Glewwe, 2000, volumes 1 and 3). Discussions were also held with colleagues with research experienced in this field and a consensus was reached on the importance of finding out more about how parental attitudes to the health and education of their boy and girl children influence decision making at the household level and how teacher's attitudes towards health factors influence the support provided by the school for children's learning.

The third question would be addressed through school-based action research to identify, trial and improve a whole school approach to health specifically tailored to address the barriers to educational access and achievement identified in the case studies in each country. These interventions are likely to include implementing a whole school approach to health that would include efforts to (i) influence parental attitudes (ii) identify, assess and monitor children made vulnerable by their own poor health or that of their family (iii) provide (as needed) psychosocial support and referral to health professionals. It the CREATE team do not wish to become involved in supporting school-based intervention then detailed recommendations could be made for other governmental or non-governmental agencies to take forward.

6.5 Concluding comments

This literature review has shown that poor health and nutrition make a significant contribution to educational exclusion across the first three Zones of the CREATE Access model. Millions of children in developing countries are missing out now on education because of health threats that do not similarly impact on children in more developed countries.

To reach the MDGs for education health issues will need to be addressed at all levels of the education system. Although the response of the education system to meeting children's health and nutrition needs is expanding, it lacks necessary urgency, remains unfocused and is still limited in scope. There is an important role here for education researchers to expand and contextualise the knowledge base through further empirical studies in different country contexts. Studies are needed to further illuminate the inter-relationships between health and education outcomes and build cogent economic and political arguments that will influence policy and funding decisions.

References

Afenyadu, D. & Goparaju, L. (2003) Adolescent sexual. and reproductive health in Ghana. *Occasional Report No. 13.* Washington DC: CEPDA. (available at www.cepda.org/publications/pdf/ghana_arhbehaviour.pdf)

Ahmed, A. U. & Ninno, C. D. (2002) The Food for Education Programme in Bangladesh: an evaluation of its impact on educational attainment and food security. In Institute, *International Food Policy Research Institute (IFPRI) Discussion Papers No 138.* Washington DC,

Alderman, H., Behrman, J. R., Victory, L. & Menon, R. (2001) 'Child health and school enrollment: a longitudinal analysis,' *The Journal of Human Resources,* 36**:** 185-205.

Alderman, H., Conde-Lule, J., Sebuliba, I., Bundy, D. & Hall, A. (2006) 'Effect on weight gain of routinely giving albendazole to preschool children during child health days in Uganda: cluster randomised controlled trial,' *British Medical Journal,* 333: 122-127.

Anderson, J. W., Johnstone, B. M. & Remley, D. T. (1999) 'Breastfeeding and cognitive development: a meta-analysis,' *American Journal of Clinical Nutrition,* 70.

Aukett, M. A., Parks, Y. A., Scott, P. H. & Wharton, B. A. (1986) 'Treatment with iron increases weight gain and psychomotor development,' *Archives of Disease in Childhood,* 61.

Awasthi, S., Pande, V. K. & Fletcher, R. H. (2000) 'The effectiveness of albedazole in improving the nutritional status of preschool children in urban slums,' *Indian Paediatrics,* 37**:** 19-29.

Behrman, J. R. (1996) 'The impact of health and nutrition on education,' *World Bank Research Observer,* 11**:** 23-37.

Bennell, P. (2003) 'The Impact of the AIDS Epidemic on Schooling in Sub-Saharan Africa,' *Working document produced for the ADEA Biennial Meeting (Mauritius, December 3-6, 2003).* Paris. France, Biennial Meeting (Mauritius, December 3-6, 2003).

Bennell, P. (2005a) 'The Impact of the AIDS Epidemic on Teachers in Sub-Saharan Africa,' *The Journal of Development Studies* 41**:** 440-466.

Bennell, P. (2005b) 'The Impact of the AIDS Epidemic on the Schooling of Orphans and Other Directly Affected Children in Sub-Saharan Africa,' *Journal of International Development Studies,* 41**:** 467-488.

Bennell, P. & Akeyampong, K. (2006) *Is there a teacher motivation crisis in sub-Saharan Africa and South Asia.* Brighton, Knowledge and Skills for Development.

Berkman, D. S., Lescano, A. G., Gilman, R. H., Lopez, S. L. & Black, M. M. (2002) 'Effects of stunting, diarrhoeal disease, and parasitic infection during infancy on cognition in late childhood: a follow-up study,' *The Lancet,* 359**:** 564-571.

Bicego, G., Rutstein S. & Johnson, K. (2003) 'Dimensions of the emerging orphan crisis in sub-Saharan Africa,' *Social Science and Medicine,* 56**:** 1235-1247.

Bobonis, G. J., Miguel, E. & Sharma, C. P. (2004) 'Iron deficiency anemia and school participation,' *Poverty Action Lab.* Paper no. 7.

Boivin, M. J. (2002) 'Effects of early cerebral malaria on cognitive ability in Senegalese children,' *Journal of Developmental and Behavioural Pediatrics,* 23: 353-364.

Boler, T. & Jellema, A. (2005) 'Deadly inertia: A cross-country study of educational responses to HIV/AIDS,' Brussels, Global Campaign for Education.

Bundy, D. (2005) 'School health and nutrition: Policy and programs,' *Food and Nutrition Bulletin,* 26**:** S186 - S192.

Bundy, D. A. P. & De Silva, N. R. (1998) 'Can we deworm this wormy world?' *British Medical Bulletin,* 54**:** 421-432.

Cairns, R. B., Elder, G. H., Jr., & Costello, E. J. (1996). The making of developmental science. In R. B.. Cairns, G. H. Elder, Jr., & J. Costello, Eds., Developmental science, (pp. 223-234). New York:. Cambridge University Press. **...**

Carr-Hill, L. R., Katabaro, K. J., Katahoire, A. R. & Oulai D. (2002) *The impact of HIV/AIDS on education and institutionalizing preventive education*. Paris, UNESCO/IIEP.

Chang, S. M., Walker S. P., Grantham-McGregor, S. M. & Powell, C. A. (2002) 'Early childhood stunting and later behaviour and school achievement,' *Journal of Child Psychology and Psychiatry,* 43**:** 775-783.

Daniels, M. C. & Adair, L. S. (2004) 'Growth in Young Filipino Children Predicts Schooling Trajectories through High School,' *Journal of Nutrition,* 134**:** 1439-1446.

Drake, L., Maier, C., Jukes, M., Patrikios, A. & Bundy, D. (2000) 'School-Age Children - their nutrition and health.' *SCN News (United Nations System Standing Committee on Nutrition),* 45 pages. Article reprinted by the Partnership for Child Development, Imperial College, University of London.

Galal, O. M., Neumann, C. G. & Hulett, J. (2005) International Workshop on Articulating the Impact of Nutritional Deficits on the Education for All Agenda. *Food and Nutrition Bulletin (UNU),* 26(2)(Suppl.2).

Glewwe, P. (2005) 'The impact of child health and nutrition on education in developing countries: theory, econometric issues, and recent empirical evidence,' *Food and Nutrition Bulletin,* 26**:** S235-S250.

Glewwe, P. & Jacoby, H. G. (1995) 'An Economic-Analysis of Delayed Primary-School Enrollment in A Low-Income Country - the Role of Early-Childhood Nutrition,' *Review of Economics and Statistics,* 77**:** 156-169.

Glewwe, P., Jacoby, H. G. & King, E. M. (2001a) 'Early childhood nutrition and academic achievement: a longitudinal analysis,' *Journal of Public Economics,* 81**:** 345-368.

Glewwe, P. & King, E. M. (2001b) 'The Impact of Early Childhood Nutritional Status on Cognitive Development: Does the Timing of Malnutrition Matter?' *World Bank Economics Review,* 15**:** 81-113.

Gopaldas, T. (2005) 'Improved effect of school meals with micronutrient supplementation and deworming,' *Food and Nutrition Bulletin,* 26.

Grantham-McGregor, S. (1995) 'A review of the studies of the effect of severe malnutrition on mental development,' *Journal of Nutrition,* 125**:** 2233-2238.

Grantham-McGregor, S. (2003) 'Does iron-deficiency anemia affect child development?' *Pediatrics,* 112**:** 978.

Grantham-McGregor, S. (2005) 'Can the provision of breakfast benefit school performance?' *Food and Nutrition Bulletin,* 26**:** 144-158.

Grantham-McGregor, S. & Baker-Henningham, H. (2005) 'Review of the evidence linking protein and energy to mental development,' *Public Health Nutrition,* 8**:** 1191-1201.

Grantham-McGregor, S., Powell, C., Walker, S., Chang, S. & Fletcher, P. (1994) 'The long-term follow up of severely malnourished children who participated in an intervention programe,' *Child Development* 65**:** 428-39.

Grantham-McGregor, S. & Walker, S. (1998) 'Health and Nutritional Determinants of School Failure,' *Nutrition, health and child development research advances and policy recommendations.* Washington D.C.: PAN American Health Organization.

Grantham-McGregor, S. M., Walker, S. P., Chang, S. M. and Powell, C. A. (1997) 'Effects of early childhood supplementation with and without stimulation on later development in stunted Jamaican children,' *American Journal of Clinical Nutrition,* 66**:** 247-253.

Grigorenko, E. L. et al. (Submitted) 'Effects of antiparasitic treatment on dynamically and statically tested cognitive skills over time,' (in press in Applied Developmental Psychology).

Grosh, M. & Glewwe, P. (2000) *Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 years of the Living Standards Measurement Study,* Washington D.C.: The World Bank.

Guo, G. (1998) 'The Timing of the Influences of Cumulative Poverty on Children's Cognitive Ability and Achievement,' *Social Forces,* 77**:** 257.

Hall, A., Bobrow, E., Brooker, S., Jukes, M. et al. (2001) 'Anaemia in schoolchildren in eight countries in Africa and Asia,' *Public Health Nutrition,* 4**,** 749-756.

Hepburn, A. (2004) Chapter 8 Increasing Primary Education Access for Children in AIDS-Affected Areas. In Coombe, C. (Ed.) *The HIV Challenge to Education: A collection of essays.* International Institute for Educational Planning.

Holding, P. A.Stevenson, J., Peshu, N. and Marsh, K. (1999) 'Cognitive sequelae of severe malaria with impaired consciousness,' Transactions of the Royal Society for Tropical Medicine and Hygiene, 93: 529-534.

Horton, S. & Ross, J. (2003) 'The economics of iron deficiency,' *Food Policy,* 28**:** 51-75.

Huda, S. N., Grantham-McGregor, S. M., Rahman, K. M. and Tomkins, A. (1999) 'Biochemical Hypothyroidism Secondary to Iodine Deficiency Is Associated with Poor School Achievement and Cognition in Bangladeshi Children,' *Journal of Nutrition,* 129**:** 980-987.

Human Rights Watch (2001) *Scared at School: Sexual violence against girls in South African Schools.* New York: Human Rights Watch.

Hunter, S. & Williamson, J. (2000) A review of current literature on the impact of HIV/AIDS on children in sub-Saharan Africa. *AIDS 2000*,14 (supplement 3):S275-S284

Hutchinson, S. E. Powell, C. A., Walker, S. P., Chang, S. M. and Grantham-McGregor, S. M. (1997) 'Nutrition, anaemia, geohelminth infection and school achievement in rural Jamaican primary school children,' *European Journal of Clinical Nutrition,* 51**:** 729-735.

Idjradinata, P. & Pollitt, E. (1994) 'Reversal of developmental delays in iron-deficient anemic infants treated with iron,' *Lancet,* 131**:** 6495-6665.

Ishikawa, N. (Forthcoming) 'The Psychosocial impact of HIV and AIDS on affected school children in Thailand,' *Lifelong Education and International Development.* London: University of London, Institute of Education.

Jamison, D. T., Breman, J. G., Measham, A. R., Alleyne, G., Claeson, M., Evans , D. B., Jha, P., Mills, A and Musgrove, P. (1993) Disease Control Priorities in Developing Countries. New York: Oxford University Press.

Jukes, M. (2005) 'The long-term impact of preschool health and nutrition on education,' *Food and Nutrition Bulletin,* 26**:** 193 - 200.

Jukes, M. & Desai, K. (2005) Education and HIV/AIDS. *UNESCO Global Monitoring Report 2005*. UNESCO.

Jukes, M. C. H., Nokes, C. A., Alcock, K. J., Lambo, J. K., Kihamia, C., Ngorosho, N., Mbise, A., Lorri, W., Yona, E., Mwanri, L., Baddeley, A. D., Hall, A., and Bundy, D. A. (2002) 'Heavy Schistosomiasis associated with poor short-term memory and slower reaction times in Tanzanian schoolchildren,' *Tropical Medicine and International Health,* 7: 104-117.

Jukes, M. C. H., Pinder, M., Grigorenko, E. L., Banos Smith, H., Bariau-Meier, E. and Walraven, G. and others (in press) 'The impact of malaria chemoprophylaxis in early childhood on cognitive abilities and educational attainment 14 years later: follow-up of a randomized controlled train in The Gambia, West Africa,' (under review). *PLOS: Clinical Trials*.

Kelly, M. (2000a) 'Planning for education in the context of HIV/AIDS,' *Fundamentals of Education Planning.* Paris: UNESCO/IIEP.

Kelly, M. J. (2000b) *The encounter between HIV/AIDS and education,* Lusaka: School of Education, University of Zambia.

Kvalsig, J. D., Cooppan, R. M. & Connolly, K. J. (1991) 'The effects of parasitic infections on cognitive processes in children,' *Annals of Tropical Medical Parastiology,* 73**:** 501-506.

Leach, F. (2004) 'Chapter 9: School-based gender violence in Africa: a risk to adolescence sexual health.' In Coombe, C. (ed.) *The HIV Challenge to Education: A collection of essays.* Paris: UNESCO/IIEP.

Levinger, B. (2005) 'School Feeding, school reform, and food security: Connecting the dots,' *Food and Nutrition Bulletin,* 26**:** 170 - 178.

Levitsky, D. A. (2005) 'The future of school feeding programmes,' *Food and Nutrition Bulletin,* 26**:** 286-287.

Lozoff, B., Andraca, I. D., Castillo, M., Smith, J. B., Walter, T. and Pino, P. (2003) 'Behavioural and Developmental Affects of preventing iron-deficiency anemia in healthy full-term infants,' *Paediatrics,* 112**:** 845-854.

Mendez, M. A. & Adair, L. S. (1999) 'Severity and Timing of Stunting in the First Two Years of Life Affect Performance on Cognitive Tests in Late Childhood,' *Journal of Nutrition,* 129**:** 1555-1562.

Miguel, T. & Kremer, M. (2004) 'Worms: identifying impacts on education and health in the presence of treatment externalities,' *Economietrica,* 72**:** 159-217.

Montresor, A., Crompton, D.W.T., Hall, A., Bundy, D. and Savioli, L. (1998) *Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level: A Guide for Managers of Control Programmes.* WHO.

Montresor, A., Ramsan, M., Chwaya, H., Ameir, H., Foum, A., Albonico, M., Gyorkos, T. W. and Savioli, L. (2001) 'School enrolment in Zanzibar linked to children's age and helminth infections,' *Tropical Medicine & International Health,* 6: 227 -231.

Nemer, L., Gelband, H. & Jha, P. (2001) *The evidence base for interventions to reduce malnutrition in Children Under Five and School-age Children in Low and Middle Income Countries* CMH. Working Paper Series. WG5 Paper No. 11. WHO: Geneva.

Partnership For Child Development (1997) 'This wormy world: Fifty years on. The challenge of controlling common helminthiases of humans today,' *Parasitology Today* 13.

Pollitt, E. (1990) *Malnutrition and infection in the classroom*. Paris, UNESCO.

Pollitt, E. (2005) 'Introduction to the Proceedings of the International Workshop on Articulating the Impact of Nutritional Deficits on the Education for All Agenda,' *Food and Nutrition Bulletin,* 26: 131-134.

Pollitt, E., Gorman, M. S., Engle P. L., Rivera, J. A., Martorell, R. (1995) 'Nutrition in early life and the fulfilment of intellectual potential,' *Journal of Nutrition,* 125: 1111-8.

Pollitt, E., Watkins, W. E. & Husaini, M. A. (1997) 'Three month nutrition supplementation in Indonesian infants and toddlers benefits memory function 8 years later,' *American Journal of Clinical Nutrition,* 66: 1357-63.

Powell, C. A., Walker, S. P., Chang, S. M., and Grantham-McGregor, S. (1998) 'Nutrition and education: a randomized trial of the effects of breakfast in rural primary school children,' *The American Journal of Clinical Nutrition,* 68: 873-879.

Pridmore, P. & Stephens, D. (1999) *Children as Partners for Health: a critical review of the Child-to-Child approach.* London: Zed Books.

Pridmore, P. & Yates, C. (2005) 'Combating AIDS in South Africa and Mozambique: The Role of Open, Distance, and Flexible Learning (ODFL),' *Comparative Education Review,* 49.

Rosso, J. M. D. & Marek, T. (1996) *Class action: improving school performance in the developing world through better health and nutrition.,* Washington D.C.: The World Bank.

Stillwater, E. (2006) *AIDS and the Ecology of Poverty*. Oxford: Oxford University Press.

Tarleton, J. L., Haque, R., Mondal, D., Shu, J., Farr, B. M., and Petri, W. A. (2006) 'Cognitive effects of diarrhea, malnutrition, and entamoeba histolytica infection on school age children in Dhaka, Bangladesh,' *American Journal of Tropical Medicine and Hygiene,* 74: 475-481.

UNAIDS (2004). Children on the Brink 2004: a joint report of new orphan estimates and a framework for action. *Children on the Brink.* New York: UNAIDS.

UNAIDS (2006). *Report on the Global AIDS Epidemic.* New York: UNAIDS.

UNICEF (1998). *State of the World's Children Report: Focus on Nutrition*. New York: UNICEF.

UNICEF (2004) *Girls, HIV/AIDS and education.* New York: UNICEF.

UNICEF (2006) *The State of the World's Children Report 2006: Excluded and Invisible*. New York: UNICEF.

UNICEF/IRC (2005) 'Water, Sanitation and Hygiene Education for Schools.' Roundtable Meeting: Roundtable Proceedings and Framework for Action.

Van Stuijvenberg, M. E. (2005) 'Using the school feeding system as a vehicle for micronutrient fortification: Experience from South Africa,' *Food and Nutrition Bulletin,* 26: 213-S219.

Walker, S. P., Chang, S. M., Powell, C. A., and Grantham-McGregor, S. (2005) 'Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-stunted Jamaican children: prospective cohort study,' *The Lancet,* 366: 1804-1807.

Walker, S. P., Grantham-McGregor, S., Powell, C. A., and Chang, S. M. (2000) 'Effects of growth restriction in early childhood on growth, IQ, and cognition at age 11 to 12 years and the benefits of nutritional supplementation and psychosocial stimulation,' *The Journal of Pediatrics,* 137: 36-41.

WHO (1995) *Global School Health Initiative*. Geneva, WHO.

WHO (2006) *Country emergency situational profile for India.* Geneva, WHO.

WHO, UNESCO, UNICEF & The World Bank (2000) *World Education Forum 2000 Focusing Resources on Effective School Health (FRESH).* Geneva, UN.

WHO & UNICEF (2005) *World Malaria Report*. Geneva, WHO.

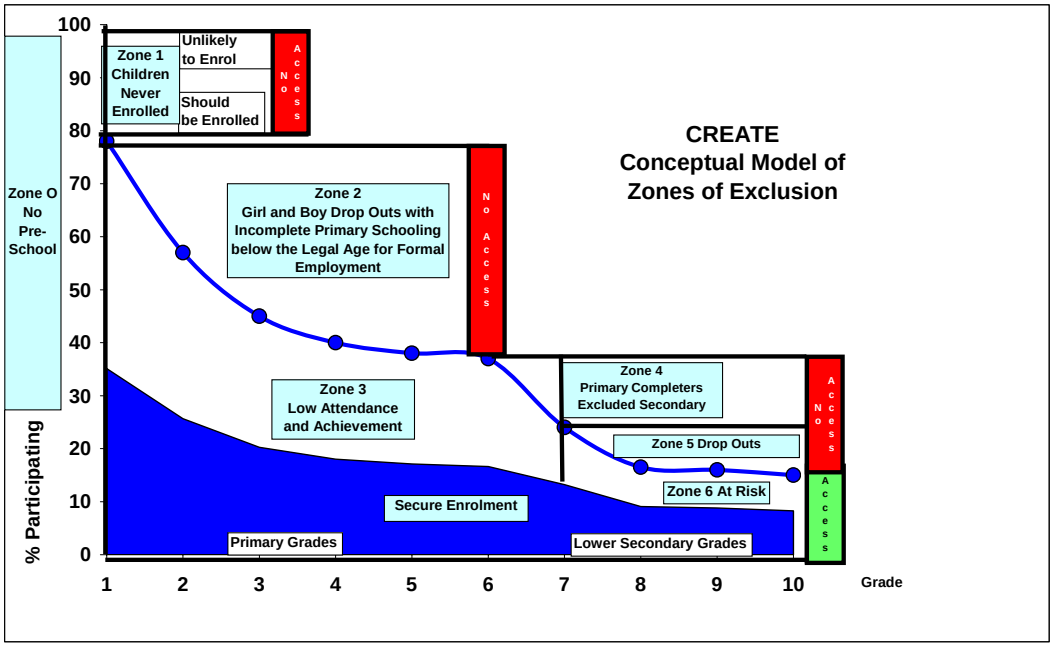
World Food Programme (2003) *HIV/AIDS & Children: Bringing hope to a generation, Food aid to help orphans and other vulnerable children*. Rome, World Food Programme.

Appendices

Appendix 1 The Research Framework

CREATE identifies six zones of exclusion[1]. The Figure below presents a cross sectional model by grade of participation which locates those who are losing or have lost access to conventional education systems. It illustrates how typically enrolments decline steeply through the primary grades in low enrolment countries, and how those attending irregularly and achieving poorly fall into "at risk" zones.

Access and zones of exclusion from primary and secondary schooling



CREATE Zones of Exclusion

Zone 0 – children who are excluded from pre-schooling

Zone 1 -children who have never been to school, and are unlikely to attend school;

Zone 2 - children who enter primary schooling, but who drop out before completing the primary cycle

Zone 3 - children who enter primary schooling and are enrolled but are "at risk" of dropping out before completion as a result of irregular attendance, low achievement, and silent exclusion from worthwhile learning

Zone 4 – children who fail to make the transition to secondary school grades

Zone 5 children who enter secondary schooling but who drop out before completing the cycle

Zone 6 children who enter secondary schooling and are enrolled but are "at risk" of dropping out before completion as a result of irregular attendance, low achievement and silent exclusion from worthwhile learning

[1] More detailed discussion of the Zones of Exclusion is presented in Lewin K M Improving Access, Equity and Transitions in Education: Creating a Research Agenda. Create Pathways to Access, Research Monograph No 1, June 2007

Appendix 2 Health Questions to go into a Household Survey Questionnaire

Part A: Questions for the mother (or primary care-giver)

How old are the children you have in this household? (Write down the name of the oldest first then fill in the rest of the table for each child. Include all children from birth to 18 years.)

Name of child	Sex (boy /girl)	Age in years and months	Current grade level	Is this the correct grade level for age? YES/NO	If no – give reason for not being at the correct grade level (or for being of school-age but not enrolled)	Have there been any health problems? (If yes – say what problems and how old the child was)*

PROMPT – What about (1) fever (2) persistent cough (3) always tired (4) stomach pain (5) worms (6) frequent diarrhoea - runny stools (7) skin rash or itching (8) open sores/boils (9) serious wound or injury (10) major accident (11) malaria (12) other – please say what.

1. **What, if anything, do you do to keep your children healthy so they can learn well?**

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2. **Do you give school children more food than other children?** YES/NO ----------

If NO: Please say why?

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4. Do you give girl children the same as boy children? YES/NO ----------

If NO: Please say why?

Part B: Anthropometry (Body measurements)

Take the following measurements for each child in the household

NAME ----------

AGE: in years and months ---------- Years/months

HEIGHT/LENGTH (to the nearest 0.5cm) First reading: ----------cm

Second reading: ----------cm

MUAC (middle upper arm circumpherence) First reading: ----------cm

Second reading: ----------cm

Appendix 3 Questions for Inclusion in School-based Surveys

Part A: Questions to ask school teachers

1.**What are the most common health (and nutrition) reasons for a student to enrol late in your school? (Write the most common first)**

Are the reasons the same for boys as for girls YES/NO ----------

If NO – what is different? ----------

Are the reasons the same for the first born child as for children born later YES/NO ----------

If NO – what is different? ----------

---

2. **What are the most common health (and nutrition) reasons for your students to be absent? (Write the most common first)**

Are the causes the same for boys as for girls: YES/NO ----------

If NO – what is different? ----------

---

3. What are the most common health (and nutrition) reasons for your students not to learn well? (Write the most common first)

4.**When a student enrolls do you find out if they are healthy?** YES?NO ----------

If YES – How do you do this? ----------

5. **When a student is absent from school, do you keep a record of the reason for this absence?** YES/NO

If YES - Where do you keep this record? ----------

6.What, if any, training have you had for giving emotional (psychosocial) support to your students?

---

7. What if any training have you, or any other teacher in this school had to support children with special learning needs?

---

8. What, if anything, is your school doing to promote the health and nutritional status of the students? (Tick the box)

(i) teaching health education in the curriculum ☐

(ii) health clubs ☐

(iii) provision of clean water and sanitation ☐

(iv) school feeding programme ☐

(v) referral to health services ☐

(vi) strong school-community links ☐

(vii) supportive policies – e.g. health issues in the school rules ☐

(viii) Other (please state) ----------

9. What more would you like your school to do to support children who are not learning well due to health reasons?

Part B: Questions to ask students

What is your name?---------- Sex ?(Boy/Girl) ----------Age? (in years and months) ----------
What grade are you in ? ---------- How many times, if any, have you repeated a grade?----------
1. Questions about the meals you eat:

How many meals did you eat yesterday?----------

How many of these meals contained meat or fish? ----------

How many meals did you eat the day before yesterday?----------

How many of these meals contained meat or fish? ----------

2. Questions about your health and general well-being

Taking everything together would you say you are a little bit happy, very happy or not happy? ----------
Would you describe your general health as a little bit good, very good or not good? ----------

Compared with your health one year ago, would you say your health is about the same now, better now or worse now?----------

In the next two years do you expect your health to stay the same, get better, or get worse? ----------

In the last 4 WEEKS have you had any of the following illnesses or symptoms?

(1) fever (2) persistent cough (3) always tired (4) stomach pain (5) worms (6) frequent diarrhoea - runny stools (7) skin rash or itching

(8) open sores/boils (9) serious wound or injury (10) major accident (11) malaria (12) other – please say what----------

---

3. Questions about your health and schooling

In the last 4 WEEKS how many days of schooling did you miss

because of your own ill-health? ----------
because of the ill-health of a family member? ----------

In the last 4 WEEKS, did you visit a health clinic (or hospital) to receive medical treatment? YES/NO

If YES – How many visits did you make in the last 4 weeks?

Have you ever had any major health problems that seriously affected your attendance at school? YES/NO

If YES – please say more----------

What do you do to keep yourself healthy so you can learn well at school? ----------

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What does your school do to keep you healthy? ----------

What more could your school do to keep you healthy? ----------

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Consortium for Research on Educational Access, Transitions & Equity

Funded by DFID

Report summary:
This literature review synthesises the findings from published synthetic reviews and key individual studies of health, nutrition and educational access with a particular emphasis on issues of gender, poverty, social exclusion and innovative practices. It discusses the advantages and disadvantages of the range of research designs and methods employed in these studies and the theoretical models of health and education that lie behind the studies and identifies knowledge gaps that could be filled by new empirical research. It also draws implications from the literature review for the further conceptual development of the CREATE Zones of Access model and for the design of future empirical studies paying special attention to school and community-based studies and identifying questions that could be included in household and school survey instruments.

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