# FOOD FOR **THOUGHT**

## Tackling child malnutrition to unlock potential and boost prosperity

Save the Children

EVERY ONE

# FOOD FOR **THOUGHT**

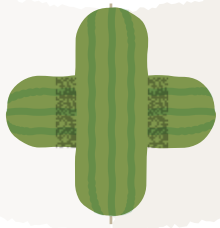
**165 million children globally are chronically malnourished.**
This not only causes the death of one child every 15 seconds but locks in lifelong problems for millions more. It's a huge problem – but also a huge opportunity.

## THE PROBLEM

## OPPORTUNITY

### HEALTH

**38% of children** from the least developed countries have had their **growth stunted** by malnutrition



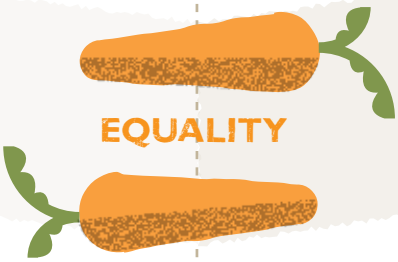
Better childhood nutrition could **cut stunting by 1/3** and reduce health issues, from diarrhoea and pneumonia to deaf-mutism

### EDUCATION

Malnourished children **score 7% lower in maths** tests and are **19% less likely to be able to read** aged 8


Well nourished children are **13% more likely to be in the correct grade at school,** boosting lifelong skills

### EQUALITY



The **poorest 40% are 2.8 times more likely** to suffer the long-term effects of malnutrition than the richest 10%

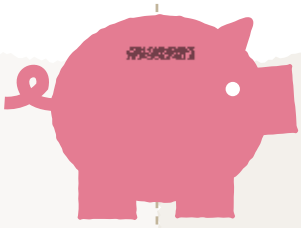
**Good health and jobs break the cycle of poverty** and ensure that every child gets a chance to thrive

### JOBS


Poor health and education limit job prospects. Childhood malnutrition **cuts future earnings by at least 20%**

By improving health and education, good nutrition leads to a more **skilful and dynamic workforce**

### ECONOMY



In total, current childhood malnutrition could **cost the global economy $125bn** when today's children grow up

Fixing malnutrition now could bring **economic benefits over 100 times as large** as the costs of interventions

Sources: UNICEF, 2013, *Improving Child Nutrition: The achievable imperative for global progress*; Save the Children, 2013, *Food for Thought*

# FOOD FOR **THOUGHT**

## Tackling child malnutrition to unlock potential and boost prosperity

Save the Children works in more than 120 countries.
We save children's lives. We fight for their rights.
We help them fulfil their potential.


## Acknowledgements

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# EXECUTIVE SUMMARY

In the past two decades, the world has achieved huge progress for children. Between 1990 and 2011, the numbers of children dying under the age of five fell faster than ever before – from 12 million to 6.9 million. Since 1999 the number of children in primary school has gone up by over 40 million.

However, malnutrition threatens to undermine these impressive advances. In spite of the reduction in children dying, the global crisis of child mortality remains unsolved – 19,000 children continue to die each day from preventable causes. Meanwhile, a global crisis in education means 130 million children are in school but failing to learn even the basics.[1] They are left without the core skills and abilities they need to fulfil their potential and to lead fulfilling, productive lives.

Child malnutrition is a key factor underlying both these crises. Malnutrition is an underlying cause of 2.3 million children's deaths a year, and for millions more children contributes to failures in cognitive and educational development. As a result, the life chances of millions of children around the world are devastated. The potential cost to the global economy runs to billions of dollars.

In the past two decades, progress in tackling malnutrition has been pitifully slow while advances in tackling many other issues highlighted by the Millennium Development Goals (MDGs) have been far faster. Save the Children's Child Development Index has shown overall progress on the education component was 32% and on the health component 23% (from the mid-1990s to the late 2000s), compared with an improvement in the nutrition component of only 13%.[2]

But in June 2013 global leaders have a historic opportunity to make a major breakthrough in the fight against hunger. By taking decisive action to tackle the malnutrition crises head on, they can end the deaths of millions of children a year as a result of malnutrition and prevent the many millions more lives being devastated by its effects.

In this report we demonstrate how investment in nutrition is not only the right thing to do, it is a down-payment on future prosperity. The evidence we present shows that preventing malnutrition of children and women in the crucial 1,000-day window – from the start of a woman's pregnancy until her child's second birthday – could greatly increase children's ability to learn and to earn.

## NEW FINDINGS ON THE IMPACT OF MALNUTRITION ON CHILDREN'S LEARNING

The long-term consequences of child malnutrition for health and resilience to disease are well established. But this report presents new evidence, commissioned by Save the Children, which for the first time identifies the impact of malnutrition on educational outcomes across a range of countries.

The Young Lives study follows 3,000 children in four countries throughout their childhood. At key points in their lives, the children are interviewed and tested to determine their educational abilities, confidence, hopes and aspirations.

New analysis of the survey shows that children who are malnourished at the start of life are severely disadvantaged in their ability to learn.

Compared with non-stunted children, stunted children:

- **score 7% lower on maths tests**
- **are 19% less likely to be able to read a simple sentence aged 8, and 12% less likely to be able to write a simple sentence**
- **are 13% less likely to be in the appropriate grade for their age at school.** [3]

These impacts remain after controlling children's backgrounds, including where they grew up and went to school.

## MALNUTRITION AND CHILDREN'S LEARNING

The impact of malnutrition on children's learning is not simply that they are tired and unable to concentrate in class because they have not eaten enough on a given day. Malnutrition in the first 1,000 days – from the start of a woman's pregnancy until her child's second birthday – has a devastating impact on children's future potential. It restricts their cognitive development, means they are more likely to be sick and miss out on school, and reduces their ability to learn.[4]

This 1,000-day window is a critical time for structural brain development. Good maternal nutrition is essential: pregnant or breastfeeding mothers who can't access the right nutrients are more likely to have children with compromised brain development and who suffer from poor cognitive performance.[5] And once the child is born, nutrition continues to play a key role in ensuring the brain develops properly.[6]

But the effects of malnutrition on a child's cognitive development and education go beyond the biology of the brain. A child's nutritional status can impact on the experiences and stimulation that children receive. Parents sometimes treat a malnourished boy or girl differently because they are small, and this child is also more likely to miss school and key learning opportunities due to illness.[7]

The impact is not just on academic achievement. Malnutrition is associated with children having lower self-esteem, self-confidence and career aspirations. Malnourished children not only face direct damage to their bodies and minds, but are less confident to learn and aspire to change the situation they were born into.

## INVESTING IN NUTRITION – A CRUCIAL DOWN-PAYMENT ON FUTURE PROSPERITY

In the longer term, malnutrition can have a big impact on earnings when children reach adulthood. The effects of malnutrition on physical stature, the ability to do physical work, and on cognitive development, can lock children into poverty and entrench inequalities.

**Children who are malnourished go on to earn 20% less as adults** than the children who are well nourished.[8] But there is some evidence that the difference could be even larger – one study has estimated this earning deficit for malnourished children at 66%.[9]

This in turn means that malnutrition can act as a big barrier to economic growth. Estimates suggest that in low- and middle-income countries, the impact of malnutrition could decrease GDP by between 2% and 11%. This is partly a result of its impacts on educational development – as well as on physical productivity and health.[10]

This report presents new estimates of malnutrition's effect on GDP. By extrapolating a 20% reduction in earnings to a global level, this report shows that today's malnutrition could cost the global economy as much as $125 billion when today's children reach working age in 2030.[11]

## WHY IT'S CRUCIAL WE ACT NOW – THE POTENTIAL 'DEMOGRAPHIC DIVIDEND'

Investments in the potential of future generations are more important than ever before. With mortality rates falling rapidly but fertility rates declining at a lower rate, developing countries will experience an increase in the size of their working-age population in the next few decades. Many countries will have two people of working age for every dependent. This presents them with a critical window of opportunity to boost economic development, known as the 'demographic dividend'.

The IMF has predicted that seven of the ten fastest-growing economies in the next five years will be in Africa.[12] Meanwhile, economists have identified the 'Next 11' countries – those that have the potential for stellar economic growth in the next decade.[13] A common theme in each of these countries is the potential provided by their demographic structures.[14]

But to capitalise on the demographic dividend, developing countries must invest now in the health and skills of their future workforce. Investments made now in proven nutrition interventions could increase opportunities for millions of children to become more healthy and productive members of society. The next

generation of children in developing countries could fuel improved innovation, prosperity and job creation.

But if we fail to make that investment the consequences could be catastrophic. Not only would that leave a future public health disaster – with a huge burden placed on health systems by a generation of people left more susceptible to disease by malnutrition – but also an economic crisis. If countries are not able to take advantage of the opportunities presented by demographic changes, then in 50–60 years' time they will be left with a large cohort of elderly dependents without having generated the resources to care for them.

## MALNUTRITION: PERPETUATING INEQUALITIES

We believe that every child should have the same opportunities in life. But the harsh reality is that, even by the age of two years, millions of children's life chances have already been undermined by malnutrition. As this report highlights, malnutrition is both a cause and a driver of poverty – locking whole communities into a cycle of deprivation and entrenching inequalities across generations.

In developing countries, children born to the poorest 40% of families are 2.8 times more likely to be malnourished than those in the richest 10% – and are likely to go on to earn less than their better-off and better-nourished peers.[15] New evidence presented in this report shows that the gap in the prevalence of stunting between the poorest 40% compared with the wealthiest 10% actually increased in many parts of the world between the 1990s and 2000s.

## 2013: A HISTORIC OPPORTUNITY TO TACKLE MALNUTRITION

The scale of the challenge is huge. UN figures suggest that in 2012, 47% of children under five in southern Asia and 39% of under-fives in sub-Saharan Africa were stunted – too short for their age due to poor nutrition – and their potential severely damaged.[16] The burden of stunting in some countries is particularly devastating. In Nigeria, 10.9 million children under five are stunted while in India, the figure is 61.4 million.[17]

But the challenge is not insurmountable. And we know what needs to be done. Investing now in a package of proven nutrition interventions, along with policy changes to address underlying causes of malnutrition, would help millions of children to develop into healthy and productive members of society. It is obvious that making these changes is the right thing to do. But it is also the smart thing to do.

But nutrition remains chronically underfunded. In the past three years, donors spend an average of 0.37% of total overseas development assistance on nutrition. This situation must change.

The Scaling Up Nutrition (SUN) movement encourages countries with a high burden of malnutrition to make ambitious political and financial commitments to address malnutrition. This is crucial because malnutrition has no political champion and often falls through the cracks of responsibility between ministries of health and agriculture. Sixteen countries with a high burden of malnutrition have produced costed plans to address the malnutrition challenge – which are ready to be funded and implemented.

On 8 June 2013 the UK and Brazilian governments will host the first-ever nutrition pledging conference. It is a tremendous opportunity for the international community and national governments to make a serious commitment to addressing malnutrition by coming forward with concrete plans that include a stunting target and strong financial commitments.

Donors and developing country governments must seize this historic opportunity and make the commitments needed to tackle malnutrition. They should:

1 **Support and finance national plans to scale up nutrition**. Announce commitments to develop, and provide technical and financial support to, the implementation of evidence-based, costed nutrition plans at the country level, in SUN-member and other high-burden countries.

2 **Declare and meet interim impact targets by 2016** as part of the global goal to alleviate the burden of malnutrition in children by 2025. These must include stunting reduction targets, be aligned with the World Health Assembly nutrition targets and be based on country needs.[18]

3 **Enhance nutrition-sensitivity of agriculture initiatives so food-based approaches can contribute more to improving nutritional status.**
   - Reform the New Alliance for Food Security and Nutrition and include accountability mechanisms with detailed public plans to achieve maternal and child nutrition impacts.
   - Adapt the Global Agriculture and Food Security Program (GAFSP) to incentivise nutrition-sensitive approaches to agriculture.

4 **Ensure nutrition is a core part of the G8 Accountability Report.** Continue and enhance the nutrition chapter from the 2012 Accountability Report. Move towards comparable tracking of nutrition funding, outcomes and impacts with a mechanism for published annual updates on progress.

Furthermore, programme developers for early years support should:

5 Recognise the importance of nutrition for cognitive and educational development, and **ensure that nutrition is integrated as a key component of early years' programming**, including in early childhood care and development programmes.

6 **Integrate stimulation interventions** into early years' programmes, in order to mitigate the impacts of malnutrition on children's cognitive development.

# HUNGRY FOR LIFE

Since Adina's father died three years ago, she and her family have struggled to get by. Adina says she often goes hungry.

Even as a baby, Adina missed out on vital nutrition. Her mother, Wagaye, says she wasn't able to breastfeed Adina because she became pregnant again soon after Adina was born.

Now ten years old, Adina finds learning difficult at school and had to repeat her class last year. "I try to do well at school but I find it hard to understand what the teacher tells me," she explains.

Wagaye feels Adina's difficulties at school are partly a result of missing out on a healthy diet. "I know better nutrition is important to doing well at school," she says.

That view is backed up by Adina's teacher, who says Adina is one of the children in her class who struggles. "I try to support those in my class who aren't performing well," she says. "I take them to a separate class after school and go over things they don't understand.

"Some of my students look much too young for their age," she adds. "They're physically smaller. I can tell that, from when they were babies, they haven't been getting nutritious food. You can still see that as they get older."

PHOTO: AMERTI LEMMA/SAVE THE CHILDREN

# 1 EARLY NUTRITION, COGNITIVE DEVELOPMENT AND EDUCATION

The 1,000 days from the start of a woman's pregnancy until her child's second birthday are a critical time for brain growth. During this period, malnutrition affects the structural and functional development of the brain, directly affecting cognitive development. It also has an indirect impact, affecting the ways children learn and their ability to interact and engage with the world.

This chapter explores the ways that malnutrition affects children's brain development and reviews evidence linking these detrimental effects with poor cognitive abilities or educational outcomes. New analysis is presented showing that malnourished children are more likely to fall behind at school and to fail on key tests of literacy and numeracy.

Good nutrition is essential for pregnant women, breastfeeding mothers and young children, especially before their second birthday. Key nutrients are vital to brain functioning and growth, including while a foetus is in the womb and during the early months after birth when the brain grows rapidly.

Children's cognitive abilities and achievement of appropriate development milestones depend on a combination of factors, including appropriate nutrition, good health, a caregiver's attention and opportunities to interact with the environment.[20] Evidence suggests that programmes that address stimulation and nutrition together result in greater improvements in child development than those that focus on one of these factors in isolation.[21]

## DIRECT EFFECTS OF MALNUTRITION ON BRAIN DEVELOPMENT

### PROTEIN AND ENERGY

Brain growth and neurodevelopment begin in the womb. During this period of rapid growth, protein and energy (from carbohydrates and fat) are critical. A lack of these nutrients can have extremely damaging effects: studies show a higher prevalence of brain abnormalities at two years of age among children affected by foetal undernutrition.[22] Studies of young children with protein–energy malnutrition show brain atrophy – a shrinking of brain cells due to a lack of nutrients,[23] as shown in figure 2.

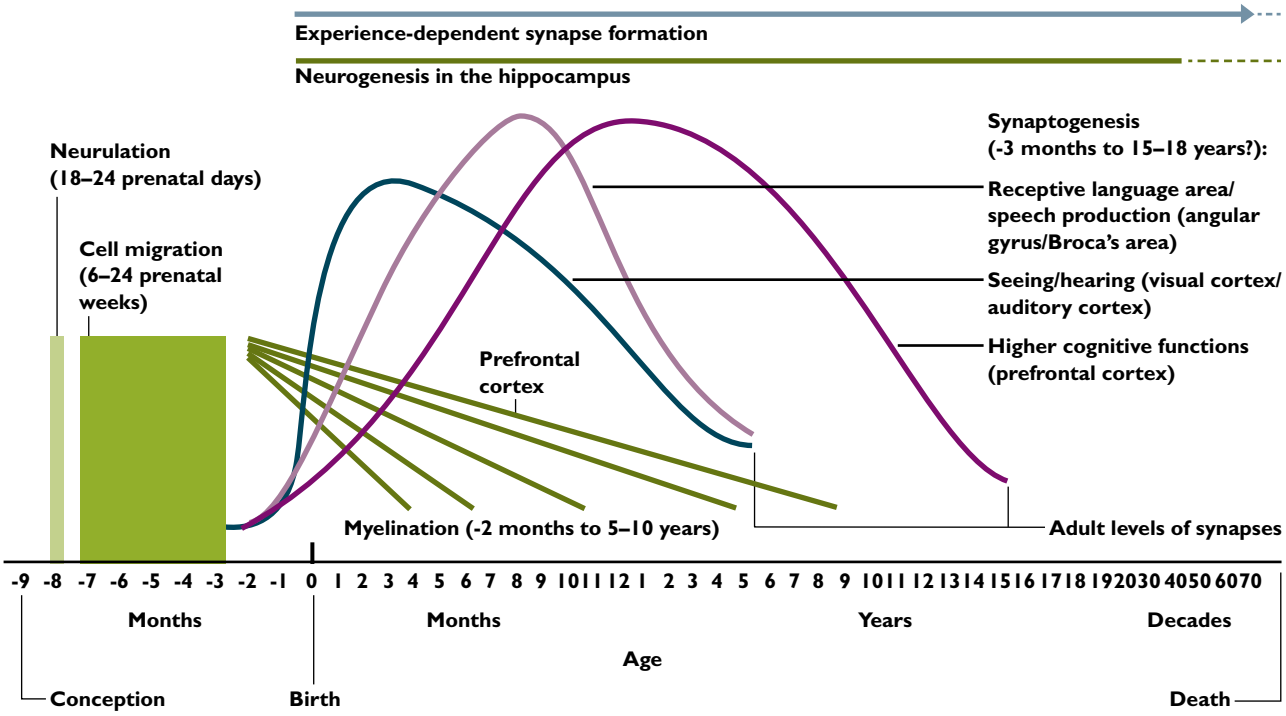
Insufficient calories continue to affect children's brain development in the first months after birth – a time of rapid neurodevelopment, including the establishment of the parts of the brain crucial for memory (the hippocampal-prefrontal connections,[24] and the density of dentrites that connect nerve impulses to the nerve cell body in the hippocampus).[25]

### MICRONUTRIENTS FOR BRAIN GROWTH

Key micronutrients are crucial for neural development early on in life. The neural tube begins to form 16 days after conception and within seven months resembles the adult brain. While brain development processes are complex and cannot be fully explored here, the evidence suggests key micronutrients are crucial to the health of children and mothers.

The presence of **iron** in the brain is critical for myelination, the process by which a layer of fat

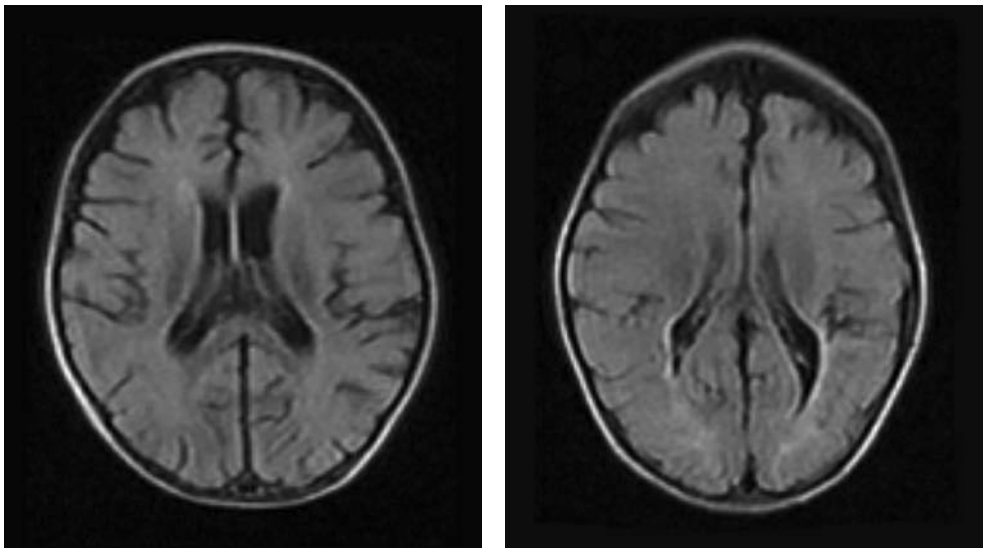
## FIGURE 1 THE DEVELOPMENTAL COURSE OF HUMAN BRAIN DEVELOPMENT




**This figure shows that the rapid period of brain development occurs within the 1,000-day window between the start of a woman's pregnancy and her child's second birthday.**

Source: Thomson, Nelson (2001) *Developmental Science and the Media.*[19]

## FIGURE 2 IMAGES OF THE BASAL GANGLIA OF A MALNOURISHED CHILD BEFORE AND AFTER TREATMENT FOR THE MANAGEMENT OF ACUTE MALNUTRITION



**The image on the far left shows the bottom part of the brain of a 10-month-old child suffering from severe protein energy malnutrition. Cerebral atrophy, the shrinking of neurons due to lack of nutrients, can be seen as the white areas shrink away from the skull and blood vessels. The image on the near left shows the same brain after 90 days of treatment, from which the problem can be seen to be resolved.**

Source: El-Sherif et al (2012) *Cranial Magnetic Resonance Imaging (MIR) Changes in Severely Malnourished Children before and after Treatment.*[26]

accumulates around neurons – brain cells designed to carry electrical signals. Myelination enables nerve cells to transmit information faster and allows for more complex brain processes. Iron deficiency prior to three years of age is likely to result in profound and possibly permanent myelin changes.[27]

Iron also facilitates the production of neurotransmitters – the chemicals that pass messages between neurons – and it is involved in the function of neuro-receptors, which receive the neurotransmitters' messages.[28] Growing evidence suggests that maternal iron deficiency in pregnancy reduces foetal iron stores, perhaps well into the first year of life.[29] This leads to greater risk of impairments in future mental and physical development.

Iron deficiency is a strong risk factor for both short-term and long-term cognitive, motor and socio-emotional impairment.[30] Furthermore, longitudinal studies consistently indicate that children who are anaemic during infancy have poorer cognition, lower school achievement and are more likely to have behaviour problems in later childhood – an effect that could occur as a result of direct biological processes or as a result of the impact of anaemia on children's learning experiences.[31]

Iron deficiency is widespread. Almost half of children in low- and middle-income countries – 47% of under-fives – are affected by anaemia,[32] and half of these cases are due to iron deficiency.[33] According to the World Health Organization (WHO), 42% of pregnant women – 56 million women – suffer from anaemia.[34]

**Iodine** deficiency is thought to be the world's single greatest cause of preventable mental retardation. In 2007, WHO estimated that nearly 2 billion people had insufficient iodine intake, one-third of them children of school age.[35]

Iodine is critical to the production of thyroid hormones, which are essential for the development of the central nervous system. Severe iodine deficiency before and during pregnancy can lead to underproduction of thyroid hormones in the mother and cretinism in the child.[36] Cretinism is characterised by mental retardation, deaf-mutism, partial deafness, facial deformities and severely stunted growth. It can lead on average to a loss of 10–15 IQ points.[37] Even in the absence of overt cretinism, chronic iodine deficiency can affect intelligence[38] and mild iodine deficiency can reduce motor skills.[39]

**Zinc** plays an important role in brain development and is thought to be essential for efficiency of communication between neurons in the hippocampus, where learning and memory processes occur.[40] It is also key to other biological processes that affect brain development, including DNA and RNA synthesis and the metabolism of protein, carbohydrates and fat.[41] While the results of studies on the impact of zinc supplementation on cognitive outcomes are inconsistent,[42] there appears to be a relationship between zinc deficiency and children's cognitive and motor development, including among low birth-weight children. More research is clearly warranted.[43]

**Folate** is required during early foetal development to prevent neural tube defects[44] and ensure that the neural tube forms properly to create the brain and spinal cord. Iron folate supplementation is also important for pregnant and breastfeeding mothers to prevent iron deficiency anaemia.

**Vitamin B12** and folate work together to produce red blood cells. Research shows that deficiencies in both could affect brain development in infants.

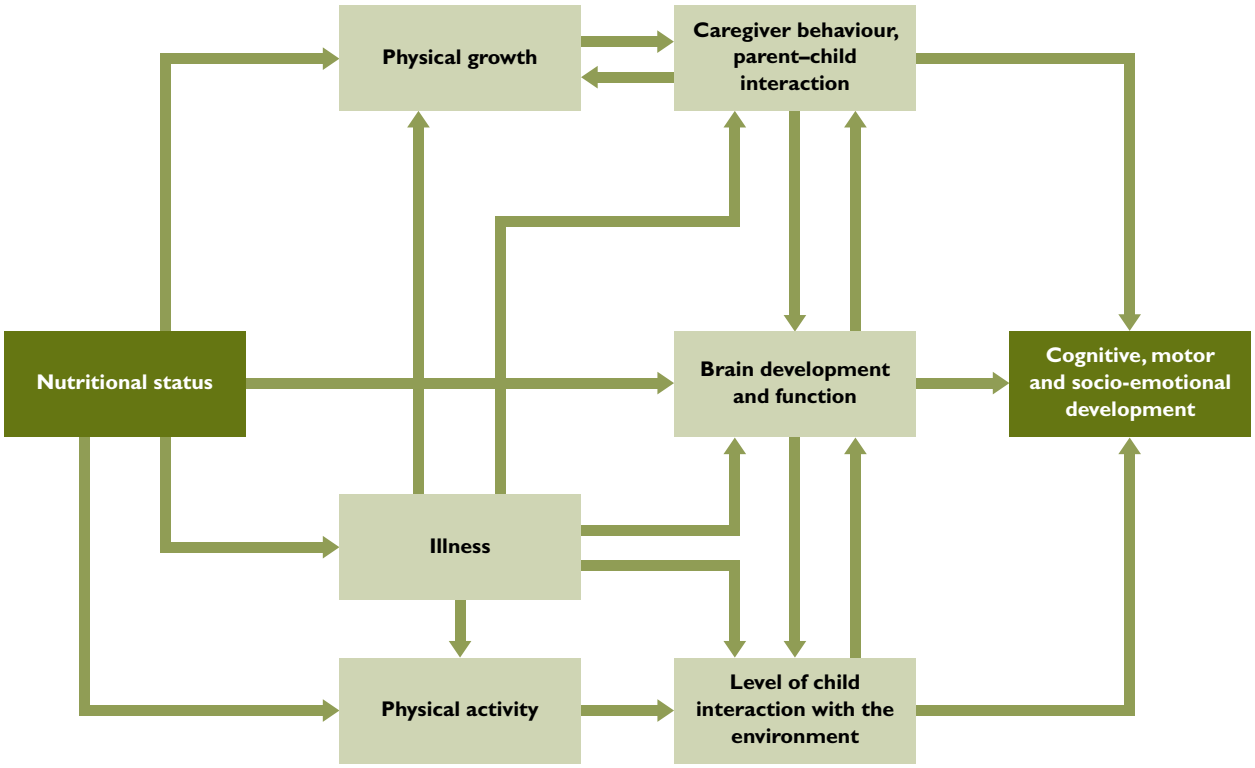
Like iron, vitamin B12 is also essential to the myelination process. Neurological symptoms of vitamin B12 deficiency appear to affect the central nervous system, and in severe cases cause brain atrophy.[45]

## THE IMPACT OF MALNUTRITION ON CHILDREN'S EDUCATIONAL EXPERIENCES

In addition to the biological factors discussed above, children's experiences and environment are important for brain development. A child's nutrition can influence the way that they interact with their environment.

The brain relies on certain stimuli for its normal development – for example, visual input through the optic nerve is crucial for the development of the visual cortex (the part of the brain that processes images). So-called 'experience expectant' processes such as these happen early in life and have long-term effects.[46] In turn, 'experience-dependent' processes, such as the brain responding to the development of a skill, continue throughout life as the brain's structure and connections change in response to the stimuli and activities the individual experiences.[47]

FIGURE 3 POTENTIAL MECHANISMS FOR THE EFFECT OF NUTRIENT DEFICIENCY ON CHILDREN'S COGNITIVE, MOTOR AND SOCIO-EMOTIONAL DEVELOPMENT




Source: Elizabeth Prado and Kathryn Dewey (2012) Adapted from Levitsky & Barnes (1972) and Pollitt (1993)

Some of the pathways that might influence cognitive and brain development can be seen in figure 3. These pathways are complex and interrelated, and the direct effects of malnutrition cannot be isolated from the impacts of psychosocial stimulation. In fact, research suggests that interventions that address stimulation and nutrition together result in greater improvements in child development than interventions that address one of these factors in isolation.[48]

Malnutrition can affect cognitive development by influencing children's experiences and the stimulation that they receive. For example, infants whose mothers' suffer from severe anaemia show symptoms of lethargy that may affect their ability to explore their surroundings.[49] There is evidence to suggest that adults may treat children who are small for their age (as a result of malnutrition) as younger than they actually are; the lower level of stimulus can affect children's cognitive development.

Once children get behind in their cognitive development, this can be reinforced by parents focusing their attention towards those children who show stronger potential.[50] A study in Mexico found that mothers of malnourished children behaved differently from other mothers towards their children – they were less likely to reward their children's successes, were less affectionate and spent less time talking to them.[51]

Children who are malnourished may also receive lower levels of stimulus as a result of poor health – for example, missing opportunities to learn through increased frequency of illness.

Malnutrition can be compounded by other forms of disadvantage. Children from better-off families who are stunted tend to be less disadvantaged in their development, partly thanks to a protective environment that can shelter then from the worst effects of malnutrition.[52] For example, these children may have better access to healthcare and so have to miss fewer days of school. By contrast, malnourished children growing up in poorer environments may be less able to apply these mitigating strategies.[53] As a result the effects of malnutrition go unabated.

## NEW ESTIMATES OF THE IMPACT OF CHRONIC MALNUTRITION ON COGNITIVE AND EDUCATIONAL OUTCOMES

A number of studies have aimed to measure the effect of malnutrition – particularly of stunting – on cognitive, educational and socio-emotional development, both at school age and in adult life.[54]

A study analysing data from Vietnam found negative effects on child cognitive development after controlling for other factors such as wealth and parental education.[55] A large landmark study in Guatemala estimated that being stunted at age 36 months is associated with going on to receive on average 3.6 fewer grades of schooling compared with children who are not stunted, and scoring significantly worse on scores of reading and vocabulary tests.[56] Estimates based on five different cohort studies suggest that children who are stunted at age two were 16% more likely to fail a grade than non-stunted children.[57]

But most existing estimates of the impact of stunting on educational and cognitive outcomes are restricted to one country or one study sample. To estimate the impact of stunting on cognitive and educational development across countries, Save the Children commissioned new analysis of the international Young Lives study, which investigates children's development. The study consists of a large longitudinal sample covering four countries in three continents – Ethiopia, India, Peru and Vietnam.[58] This analysis isolates nutrition from other factors that are relevant to cognitive and educational development (such as school quality and parental wealth) and looks at the association of stunting at age five with cognitive and educational outcomes at age eight.

Previous analysis of the Young Lives data reinforces the links between early life malnutrition and children's later development. Stunting at around one year of age is associated with lower cognitive scores at age five in Peru and Vietnam.[59] In addition to the effects associated with poverty, stunting at eight years was associated with reduced self-efficacy, self-esteem and educational aspirations. Being less malnourished[60] was associated with higher school aspiration, self-efficacy and self-esteem.[61] These impacts on the ways in which children feel and think about themselves are likely to be closely linked with labour market outcomes in later life.[62]

New analysis commissioned by Save the Children (see table 1 overleaf and Appendix 1) shows that, after controlling for children's background characteristics (such as the wealth of their family, and the community they grew up in) **children who were stunted at age five scored on average 7% worse on a maths test three years later**. This is an equivalent reduction in maths score to the child being 3.4 months younger, and represents a serious setback on their learning.

The impacts on measures of literacy are even stronger. **Children who were stunted at age five were 19% less likely to be able to read a simple sentence such as 'I like dogs' or 'The sun is hot' three years later. And they were 12.5% less likely to be able to write such a sentence.** In relative terms, these are equivalent to the child being 5.7 months or 7.4 months younger, for reading or writing respectively.

Importantly, the research finds that malnutrition affects children's chances of being in the correct grade for their age. After controlling for other factors, being stunted at age five was associated with **being 13% less likely to be in the correct grade (or above) when children reached age 8**. Children who resit grades are in turn also more likely to leave school earlier – a particular problem in settings where many children already receive inadequate amounts of schooling.

As table 2 in Appendix 1 shows, these impacts are reasonably constant across the four countries, being larger in India for three of the four indicators.

*continued overleaf*

## NEW ESTIMATES OF THE IMPACT OF CHRONIC MALNUTRITION ON COGNITIVE AND EDUCATIONAL OUTCOMES *continued*

### TABLE 1 IMPACT ASSOCIATED WITH STUNTING AT AGE 5 ON CHILD OUTCOMES AT AGE 8

See Appendix 1 for more detail from the analysis.

| **Indicator** | **After controlling for background characteristics, a stunted child would be expected to** |
|---|---|
| Maths score (29-question test) | Score 7% (0.98 points) less well |
| Made a mistake with reading a simple sentence | Be 19% more likely to make a mistake (5.9 percentage points difference) |
| Made a mistake with writing a simple sentence | Be 12.5% more likely to make a mistake (5.1 percentage points difference) |
| Being in correct grade for age | Be 13% less likely to be in the correct grade for age (8.1 percentage points difference) |

# 2 THE ECONOMIC IMPACT OF MALNUTRITION

The benefits of good nutrition do not stop with improved educational outcomes. By improving cognitive abilities, health, physical strength and stature, good nutrition in the early years can lead to greater wages in adulthood and hence promote the economic development of a whole country. This chapter presents evidence that stunted children earn as much as 20% less than their counterparts, and uses this to estimate that today's malnutrition could potentially cost the global economy $125 billion when children born now reach working age.

The next few decades will see key emerging economies, as well as several low-income countries in sub-Saharan Africa, experience demographic changes that provide important opportunities for economic growth. But to benefit from these potential dividends, they must invest now in the health and education of their future workforce. Governments and donors must invest in the nutrition of these children if they are to ensure strong economic growth in years to come.

The interrelation between improved nutrition and economic growth is of great importance for human and economic development. It is a two-way relationship. On the one hand, inclusive economic growth can contribute towards reductions in the prevalence of malnutrition. On the other hand, as this section will show, reductions in malnutrition can have a transformative effect on the economic potential of individuals and whole societies.

## MALNUTRITION AND ECONOMIC OUTCOMES IN LATER LIFE

Through its impact both on children's cognitive development and on their physical health and development, malnutrition can have significant effects on an individual's economic well-being in later life. The World Bank suggests that malnutrition results in 10% lower lifetime earnings,[63] while numerous studies that model the impact of malnutrition in the first two–five years of life place this figure at 20%.[64]

The 2008 *Lancet* series reviewed cohort studies from Brazil, Guatemala, India, the Philippines and South Africa that all followed children into adulthood, and concluded that stunting is associated with reduced earnings in later life.[65] This review found that less severe stunting in Brazil and Guatemala was associated with higher adult incomes among both men and women.[66] Models using evidence from across these longitudinal studies, combined with evidence on the relationship between education and earnings taken from 51 countries, have estimated that children who are stunted at age five earn 22% less than their non-stunted counterparts.

Children from the families living in the most extreme poverty often suffer the highest rates of malnutrition.[67] Therefore, being malnourished often goes hand-in-hand with several other barriers that undermine children's development, making it difficult to distinguish between the impacts of malnutrition and other closely correlated forms of deprivation.

In Guatemala, a landmark randomised controlled trial (RCT) – the best way of removing the effects other factors from research findings – tried to isolate the effects of malnutrition and found that providing boys with a nutritional supplement (which was available twice daily and contained extra protein and energy) during the first two years of life raised incomes by 46% when they were revisited during adulthood.[68] Data from the same study has been used to estimate that individuals who were not stunted in early childhood were much more likely – by 28 percentage points – to work in higher-paying skilled labour or white-collar work and earned as much as 66% more as adults – a much higher figure than others have estimated and one which may be specific to the Guatemalan context.[69]

### MULTIPLE PATHWAYS LINKING NUTRITION AND ECONOMIC OUTCOMES

Part of the impact of malnutrition on earnings may be because of the effect on children's physical development. Several studies have confirmed the correlation between adult height and wages – for example, a large cross-sectional study in Brazil found that a 1% increase in adults' height was associated with a 2.4% increase in earnings.[70]

It is likely that physical size itself (and therefore its nutrition determinants) is a direct predictor of earnings in contexts where physical strength is necessary, such as agriculture or other manual labour.[71] Similarly, malnutrition can affect earnings simply by reducing people's physical ability to spend time at work, eg, due to illness.

But in a world where jobs increasingly require cognitive skills and educational qualifications, the impacts of cognitive development and educational outcomes is another important pathway by which malnutrition can reduce wages. Poor cognitive and educational development is linked to lower wage rates, as evidence from many countries including Kenya, Tanzania, Ghana and Pakistan shows.[72, 73]

There is a clear association between education levels, and individuals' subsequent earnings.[74, 75] But critically, the latest evidence suggests that it is actual learning and the acquisition of skills that matter most, not just the number of years spent in school.[76] This is another reason why early childhood development, enhanced by good nutrition, is so critical – children need to start school ready to learn, rather than struggling to understand what the teacher is trying to teach them.

Given the importance of cognitive and educational outcomes on wages, this is likely to be a key pathway that links nutrition to later economic well-being.[77] Many of the studies that have looked at economic impacts of malnutrition also highlight the association with education – for example, the RCT in Guatemala found that boys who received the nutrient supplement had, on average, 1.2 extra years of schooling, and boys and girls given the supplement went on to achieve significantly higher reading comprehension and intelligence scores as adults.[78]

In fact, nutrition's relationships with cognitive and educational development may be the most important pathway in terms of its impacts on wages. Research has shown that the economic impacts of malnutrition are larger for those working in more skilled jobs than for those in manual jobs. A study showed that among those working for wages or operating small businesses as adults, those who had received an intervention to improve nutrition as children worked on average five extra hours per week, and earned 20% more than those who didn't.[79] These impacts were much larger than increases seen for farm workers.

## MALNUTRITION AND ECONOMIC GROWTH

Nutrition is not only important for increasing individuals' economic outcomes; it is essential for whole societies' economic development. This occurs partly as a result of the link between malnutrition and lower productivity, as this report has highlighted, with reduced earnings at the individual level leading to knock-on effects on national-level economic growth.[80] Malnutrition also affects national economies by increasing healthcare costs, as people who were malnourished as children are more likely to fall ill to diseases.

### LAYING THE FOUNDATIONS FOR THE DEMOGRAPHIC DIVIDEND

Demographic changes occurring around the world mean that investments in children's future potential are more important than ever. Europe and North America are entering a period of population ageing, with increasingly large retired populations that need supporting. But other areas of the world will, in the coming decades, experience growth in the size of their workforce that will present an opportunity for significant economic growth.

Many developing countries will, in the coming decades, have as many as two workers for every pre- or post-working-age person – a ratio that allows for improved economic growth, provided the workforce is healthy and educated, and jobs are available for them.[81] It is estimated that similar demographic changes account for one-third of the economic growth that east Asian tiger economies experienced from 1965–1990.[82]

Figure 4 shows the progress of various continents in the world through this process of demographic change. The populations of Asia and Latin America currently have a very favourable worker:dependent ratio. The proportion of India's population that is of working age is set to continue to increase. Over the next five decades, Africa will continue to see an increase in the proportion of working-age

FIGURE 4 THE WORKER:DEPENDENT RATIO OF SEVERAL CONTINENTS, PLUS INDIA

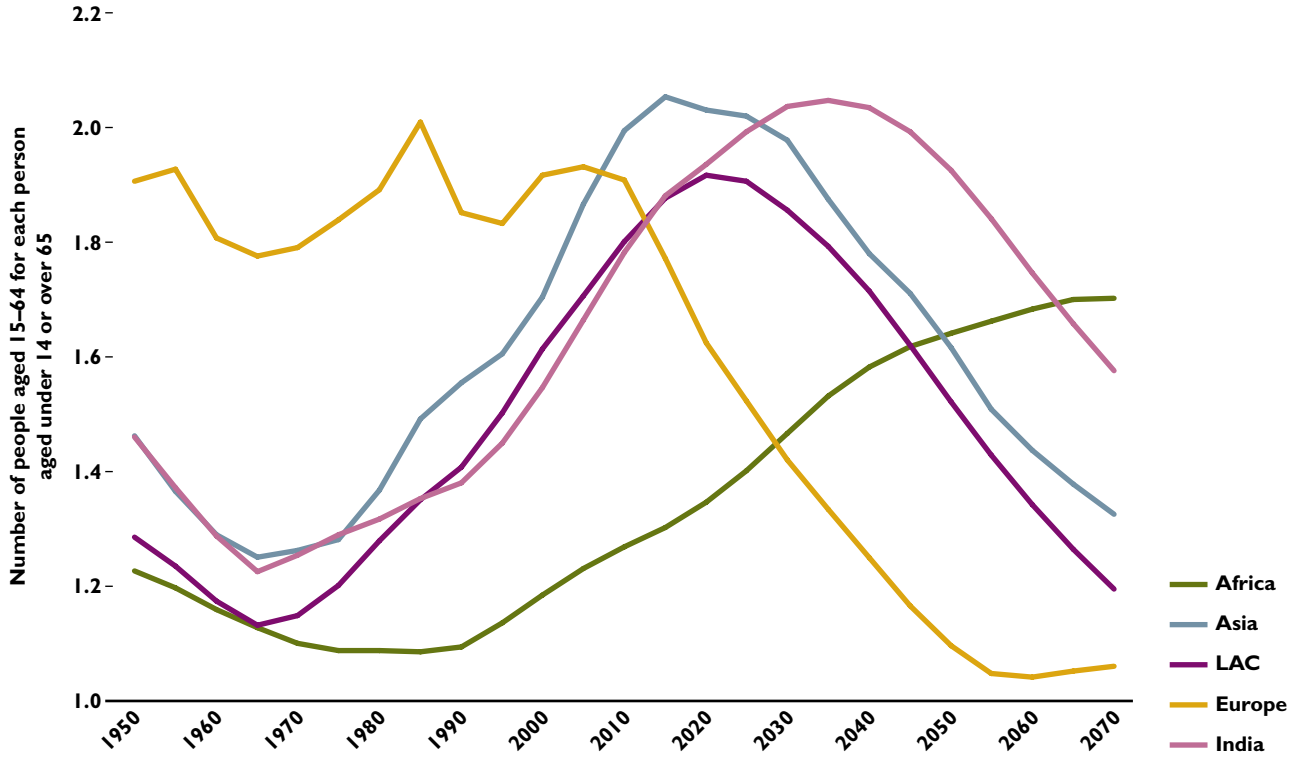



Figure constructed by Save the Children using data from UN (2010).[85]

people, creating an opportunity for the continent to experience strong growth, provided the right investments in people and jobs are made.

Failure to ensure good nutrition and human capital during these periods could prevent developing countries from experiencing sustained economic growth.[83] It could even lead to BRIC countries (Brazil, Russia, India and China) and some developing countries becoming stuck in the 'middle-income trap' – whereby their growth may plateau after reaching middle-income levels.[84]

## A BRAKE ON INCLUSIVE ECONOMIC GROWTH

Many studies have attempted to estimate the cost to national economies of various forms of malnutrition. As mentioned above, malnutrition acts both by reducing economic productivity and by increasing the costs of healthcare. While econometric methodologies require various assumptions to be made regarding the strengths of association between malnutrition and economic costs, the findings are stark.

In seven countries in Central America, the World Food Programme (WFP) has estimated that the economic costs of children under age five being underweight could be between 1.7% and 10.6% of GDP (average 6.6%).[86] Estimates of the cost of iron-deficiency to national economies are around 4.5% of GDP in ten developing countries, ranging from 2% in Honduras to 7.9% in Bangladesh,[87] and similar impacts to national economies have been estimated for iodine deficiency and underweight.[88] These different deficiencies overlap, with many of the same people affected by different types of deficiencies, which makes modelling the total economic impact of malnutrition very difficult. Nevertheless, what is clear is that malnutrition can act as a brake on countries' economic growth.

In India it has been estimated that the economic cost of micronutrient malnutrition amounts to between 0.8% and 2.5% of GDP,[89] equivalent to $15–46bn, while in China, micronutrient malnutrition alone could cost between 0.2 and 0.4% of GDP,[90] equivalent to $15–29bn.

In 2012 the Copenhagen Consensus panel of Nobel laureates estimated the economic benefits of investing in a comprehensive package of direct nutrition interventions, such as vitamin A supplementation or the promotion of breastfeeding,[91] and found that

these benefits in terms of increased wages could be anywhere between 15 and 138 times larger than the costs.

Many of these studies combine the impacts of malnutrition through various pathways, including cognitive and physical impacts of malnutrition as well as the additional costs such as those due to increased healthcare burden. Nevertheless, it is clear that reduced cognitive development is an important pathway by which nutrition affects national economies. In its 2007 study based in seven Latin American countries, the WFP estimated that as much as 46% of the overall cost of malnutrition on GDP was due to impacts on productivity via reduced education.[92] The effect of malnutrition on national economies is likely to become even more significant as countries develop larger skills sectors and as non-farm sectors become increasingly important.[93]

Save the Children has undertaken new analysis to estimate the potential costs to the global economy of the reduced potential that results from children being malnourished. We used a similar methodology to that of the Copenhagen Consensus panel of Nobel laureates, who in 2012 estimated the economic benefits of investing in a comprehensive package of direct nutrition interventions. The methodology for this analysis and the various assumptions included are shown in Appendix 2.

The results of this analysis suggest that by the time today's stunted children reach working age, the income differences associated with their malnutrition could cost the global economy $125bn per year.

In fact, the impacts of malnutrition on GDP could be even larger than a straightforward accumulation of individual impacts: the reduced cognitive skills that are associated with malnutrition could have broader effects on GDP. Research suggests, for example, that more foreign direct investment goes to countries with workforces that have greater human capital, and that this relationship has been getting stronger over time.[94]

Similarly, recent evidence suggests that the impact of cognitive development on national economies may be larger than the impact on individual wages – partly as a result of improving economic activities such as savings.[95] Finally, the evidence discussed above, that impacts may be larger in skilled sectors than traditional ones, such as agriculture, suggests that as countries move away from agrarian economies and into more skilled jobs, the impact of malnutrition on incomes may become even starker.

## MALNUTRITION – PERPETUATING INEQUALITIES

Poverty is itself a key driver of malnutrition. But malnutrition also perpetuates poverty – by reducing the potential of individuals to lift themselves out of poverty.

The poorest are worst affected by malnutrition. Save the Children analysis of DHS datasets shows that around the world, children in the poorest 40% within any country are on average 2.8 times more likely to be stunted than those in the richest 10%.[96] These inequalities are most extreme in Nicaragua, where being born into the poorest 40% means a child is 10.6 times more likely to be stunted than in the richest decile, followed closely by Peru (9.2 times) and Jordan (7.9 times).

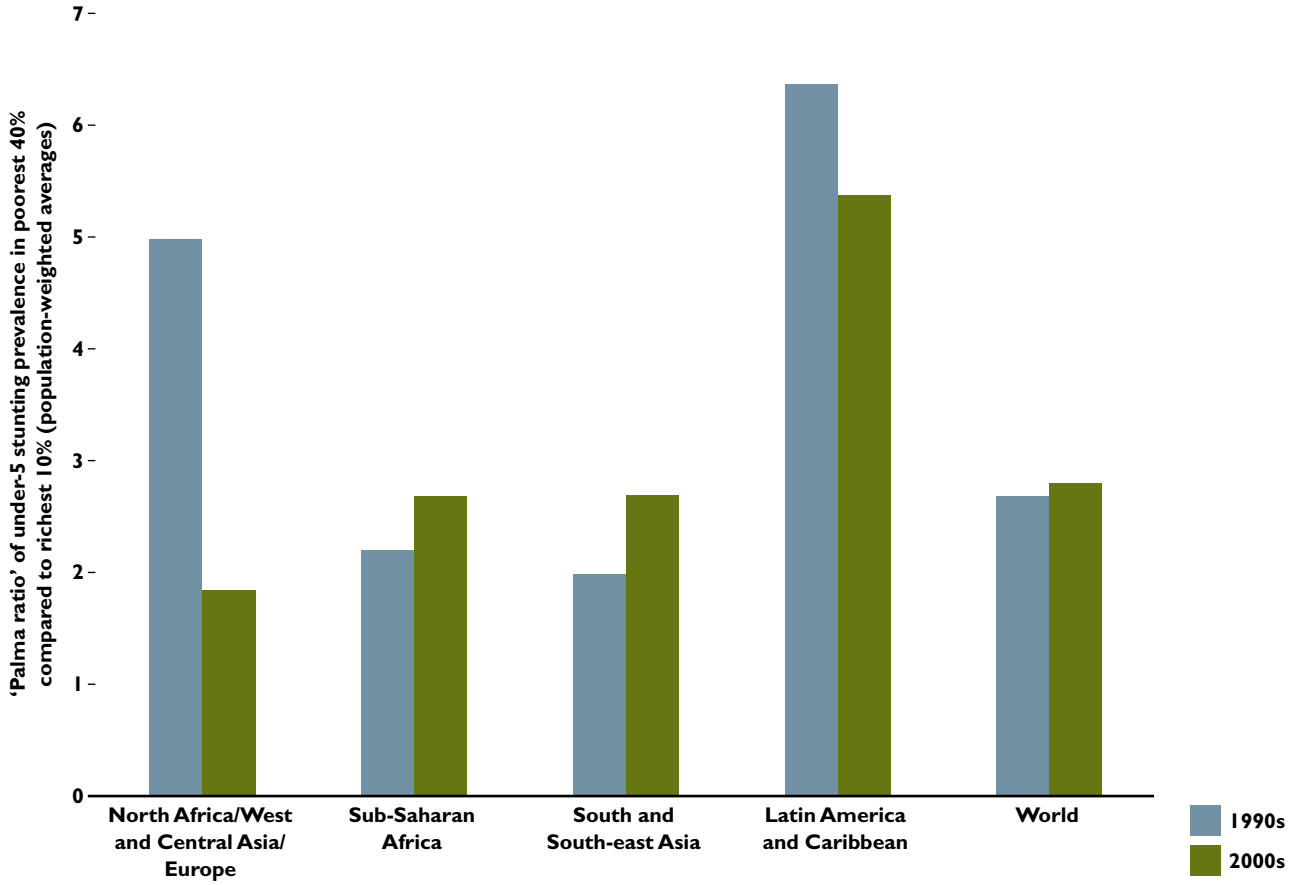
Given the resultant impacts of malnutrition on future earning potential, a vicious cycle is created – where the poorest are at greatest risk of facing permanent damage to their future learning and earning potential. The next generation is then more likely to be stunted – both through transmission from the mother during pregnancy,[97] and as a result of the poverty in which families live. Malnutrition's unequal social prevalence therefore acts as a barrier to inclusive growth and the reduction of inequalities.

A recent study using the Young Lives dataset in Andra Pradesh, India, has suggested that if nutritional inequalities were tackled in such a way that low-caste children gained the same average nutritional status as their upper caste counterparts, this would close existing caste cognitive differentials by 25%.[98]

Yet, inequalities in nutritional status between wealth groups are large and have remained stubbornly high over recent years. Figure 5 shows how the ratio of stunting between the top 10% and the bottom 40% actually increased in sub-Saharan Africa and in south and south-east Asia between the 1990s and 2000s.

While development assistance is increasingly focused on promoting growth, such growth must be inclusive and must deliver improvements to the economic and social well-being of the poorest in society. Given the social distribution of malnutrition, investments to tackle it are an important way to tackle poverty and its transmission, and to encourage children's development as empowered and productive members of society.

FIGURE 5 RATIOS IN STUNTING RATE BETWEEN TOP 10% AND BOTTOM 40% WEALTH GROUPS




Source: DHS analysis by Save the Children

# 3 INTERVENTIONS THAT MAKE A DIFFERENCE

Investing in nutrition is key to unlocking the potential of a generation of children. The good news is that we know what works to tackle malnutrition and its damaging effects on individuals and societies.

A package of 13 proven direct nutrition interventions could reduce the prevalence of stunting by a third, and child mortality by a quarter. Investments in nutrition-sensitive approaches, such as child-focused social protection systems or empowering women farmers to increase the nutrition-sensitivity of agriculture, could have even greater effects on tackling nutrition.[99] For those children who remain malnourished, interventions to promote stimulation must be implemented.

Nutrition interventions, along with key educational, health and care services, can help children's brains to develop and help them to learn and to earn for the rest of their lives, and can yield gains that benefit the wider society and economy. These include direct nutrition interventions, such as promoting breastfeeding, many of which are provided through the health system. In addition, indirect interventions – such as social protection, investments in agriculture, and ensuring access to safe water and sanitation – address nutrition's underlying causes.

There is strong evidence that points to the benefits of nutrition interventions for children's cognitive development.[100] Research into the impact of a variety of nutrition interventions, from a range of developing countries, has found a positive impact on educational indicators, such as grades completed at school,[101] maths and English scores[102] and intelligence quotient (IQ).[103] This appears to hold true across a range of robust studies.[104]

## MICRONUTRIENT SUPPLEMENTS

A recent study in Indonesia provided multiple micronutrient supplements to undernourished or anemic women during pregnancy and in the first three months after birth. The authors found that this had significant effects on their children's cognitive development, as measured by tests of visual and spatial abilities at age three.

A study in Costa Rica of iron supplementation in children aged one and two years tracked the same individuals 18 years later and tested the impact of malnutrition within different socio-economic groups, in order to isolate this factor from the analysis. Scores in cognitive tests in early childhood for those in the middle socio-economic status group with adequate iron status were 8–9 percentage points higher than those who remained anaemic in early childhood. This difference that was maintained up to age 19 years.[105] Among the lower socio-economic status group, those with adequate iron status scored 10 percentage points higher in early childhood, and this increased to 25 points at age 19.[106]

Iodine supplementation can lead to strong economic benefits – partly because of the impact of iodine deficiency on healthcare costs. Currently 31% of developing-world households still do not consume iodized salt and are therefore not protected.[107] It is estimated that, at an annual cost of $0.5 billion, universal salt iodization would save an annual $35.7 billion of potential costs attributable to iodine deficiency.[108]

## BREASTFEEDING

Breastfeeding is the best way to give a child a healthy start in life. However, only 37% of children globally are exclusively breastfed for the first six months of life.[109]

Breastfeeding prevents millions of deaths, protecting children from diseases such as pneumonia and diarrhoea. In addition, breast milk contains nutrients such as fatty acids, growth factors and hormones that are important for brain development.[110] Such is the strength of evidence, that a medical consensus has emerged regarding the importance for cognitive development of these nutrients and their provision in breastmilk.[111] The stimulation effects of breastfeeding

are also important for cognitive development: breastfeeding can help the mother and child to bond, which can in turn enhance mother and baby interaction, which is important for cognitive and socio-emotional development.[112]

A number of studies show that breastfeeding promotion can have a positive impact on child development and educational attainment. For example, a study in clinics in Belarus found that children who benefited from a breastfeeding promotion intervention had significantly higher scores on verbal and IQ tests, and higher teacher ratings for reading and writing at 6.5 years.[113] Similarly, a study on the effect of breastfeeding duration on school achievement among Brazilian adolescent boys found an increase in school achievement linked to an increase in breastfeeding duration.[114]

There are, of course, a number of factors that also influence children's academic performance, such as socio-economic status, household education levels and genetics. However, a meta-analysis of several controlled studies found that breastfeeding is associated with a higher score for cognitive development compared with formula feeding. The difference between breastfed and formula fed children was observed as early as six months and sustained into adolescence.[115]

## STIMULATION OF MALNOURISHED CHILDREN TO IMPROVE COGNITIVE OUTCOMES

As chapter 1 shows, malnutrition can affect children's interactions with their environment – for example, in the way they are treated by parents and teachers. There is therefore a need for early years' programmes to simultaneously address both nutrition and stimulation in order to have the largest positive effects on cognitive development.

In Jamaica, a study found that providing *either* nutrients (in the form of milk-based supplements for two years) *or* stimulation (in the form of weekly play sessions) both improved children's scores on tests of cognitive development. However, it also found that integrating the two interventions led to significantly better impact than either one alone.[116] Indeed recent evidence from severely underweight children in Bangladesh shows that if malnutrition cannot be prevented, interventions to improve stimulation may still be able to improve cognitive scores.[117]

It is therefore critical for children's cognitive development that interventions aimed at malnourished children integrate stimulation, in order to minimise the negative effects of malnutrition on cognitive development. Indeed, there is international consensus around the need for such interventions, which form the basis of WHO recommendations on the treatment of malnutrition.[118] Nutrition should be integrated into programmes that address early childhood care and development.

### INTEGRATING NUTRITION INTO EDUCATIONAL PROGRAMMES IN BANGLADESH

Drawing on the evidence of the importance of nutrition for early child cognitive development – as highlighted in this report – Save the Children is integrating nutrition into our early child care and development (ECCD) programming.

In Bangladesh, where 43% of children are stunted, Save the Children undertook a trial of an ECCD programme that integrated nutrition by providing 1–2 days of training on the importance of dietary diversity and nutritious food, as well as healthcare and stimulation.

The results of this study showed that mothers changed their practices relating to dietary diversity, with 64% of families in one of the intervention arms that received the nutrition education consuming at least four food groups the year after the intervention was made, compared with 33% of control families. While the programme did not run long enough to register effects on stunting, the increase in dietary diversity is likely to have had a positive impact on children's intake of nutrients.

Stimulation scores also improved significantly. Indeed, this factor was shown to be especially important in achieving an improvement to cognitive scores. Children from families who received the stimulation intervention saw a 40% improvement in their cognitive and language development compared with children who did not receive the intervention.

PHOTO: SAVE THE CHILDREN

**Kasturi (right) with her older sister, Sangeeta, and their father. Kasturi struggles at school, while Sangeeta has thrived.**

# A TALE OF THREE SISTERS

When Lakshmi was pregnant with twins, she and her family were desperately short of food.

Her husband, Srinavas, was struggling to find work. "There were times we were hungry for days," he says. "I felt very sad that I couldn't provide for my pregnant wife."

When Lakshmi gave birth, both twins had a low birth-weight. "I used to breastfeed my children, but my milk wasn't enough for both of them," she says. "We didn't have enough food then." One of her twin girls died at ten months old.

Kasturi survived and is now eight. But she struggles at school, and has already had to repeat one year. Her teacher, Chandra Kala, says, "I've been Kasturi's teacher for two years now. Her learning's very slow and there's been no major improvement."

Kasturi has an older sister, Sangeeta. The contrast in their stories is striking. When Sangeeta was born, Srinavas was earning enough money for a healthy diet for the family. Sangeeta has gone on to thrive at school.

"Sangeeta was one of our bright students in primary school," says Chandra Kala, "and I hear a lot of good things about her from her teachers in high school."

# 4 CONCLUSION AND RECOMMENDATIONS

Given the devastating human and economic impacts of malnutrition, many economists have consistently concluded that investing in nutrition is an excellent way to spur inclusive economic growth and is 'central to development'.[119]

For example, the Copenhagen Consensus of Nobel Laureates rated nutrition interventions as four of the eight most cost-effective interventions available in development. Nutrition interventions are cost-effective, in particular in reducing the burden on associated diseases on health services.[120] Cost–benefit ratios for nutrition interventions have been found as high as 1:138.[121]

Yet, despite its crucial importance and the growing consensus that this is one of the 'best buys' in development, the issue remains chronically underfunded. Donors spent an average of only 0.37% of total aid on nutrition in the past three years.

The Scaling Up Nutrition movement encourages countries with a high burden of malnutrition to make high level political and financial commitments to address malnutrition. This is crucial because malnutrition – which is silently crippling the future potential of millions of children – has no political champion and often falls through the cracks of responsibility between ministries of health and agriculture. Sixteen high-burden countries have produced costed plans to address the malnutrition challenge, and which are ready to be funded and implemented.

In the lead up to the G8 leader's summit in June, the UK Prime Minister has agreed to host, with the government of Brazil, a 'Nutrition for Growth' event – a once-in-a-decade opportunity to ensure high-level political and financial commitments to support these plans.

In 2013, the international community stand at a crossroads. Investing in nutrition interventions now as a down-payment on future prosperity will lead to huge benefits for millions of children – and for the global economy. But if we fail to take advantage of this opportunity we will fail a generation of children – and diminish the prospects of many countries and their people.

Save the Children calls on donors and governments in developing countries to seize this historic opportunity and make the commitments needed to tackle malnutrition. They should:

1. **Support and finance national plans to scale up nutrition**. Announce commitments to develop, and provide technical and financial support to, the implementation of evidence-based, costed nutrition plans at the country level, in SUN-member and other high-burden countries.
2. **Declare and meet interim impact targets by 2016** as part of the global goal to alleviate the burden of malnutrition in children by 2025. These must include stunting reduction targets, be aligned with the World Health Assembly nutrition targets and be based on country needs.[122]

3 **Enhance nutrition-sensitivity of agriculture initiatives so food-based approaches can contribute more to improving nutritional status.**
   - Reform the New Alliance for Food Security and Nutrition and include accountability mechanisms with detailed public plans to achieve maternal and child nutrition impacts.
   - Adapt the Global Agriculture and Food Security Program (GAFSP) to incentivise nutrition-sensitive approaches to agriculture.

4 **Ensure nutrition is a core part of the G8 Accountability Report.** Continue and enhance the nutrition chapter from the 2012 Accountability Report. Move towards comparable tracking of nutrition funding, outcomes and impacts with a mechanism for published annual updates on progress.

Furthermore, programme developers for early years support should:

5 Recognise the importance of nutrition for cognitive and educational development, and **ensure that nutrition is integrated as a key component of early years' programming**, including in early childhood care and development programmes

6 **Integrate stimulation interventions** into early years' programmes, in order to mitigate the impacts of malnutrition on children's cognitive development.

# APPENDIX 1
# ANALYSIS OF THE YOUNG LIVES DATASET

Young Lives is a study of childhood poverty. Central to the study is a panel data set collecting data on children and young people growing up in Ethiopia, India, Peru and Vietnam. The study collects data on two groups of children born in 1994/95, and 2000/01. The study website[1][2][3] contains policy and research analysis, as well as technical documentation and information on how to access publically archived data.

The data is collected using a clustered ('sentinel site') approach. Specific geographic sites were selected within each country with children of the right age randomly sampled within each area. The sample design aimed to collect information on children in a range of circumstances within each country (ie, to broadly reflect national differences), but oversamples poor children (technical details and comparisons with nationally representative sources are on the study website).

The study has so far collected survey data in 2002, 2006 and 2009. The analysis in this briefing uses information on the younger group of children (aged around eight when data was last collected). In this younger cohort, approximately 2,000 children were initially sampled. Since similar questions were asked in each country, in the multivariate analysis the samples are pooled (using statistical techniques to control for national differences), giving a sample of about 7,000 children (having accounted for attrition and excluding children for whom there is relevant missing data).

In this report, descriptive analysis is used to consider the different later experiences of children based on their status as 'stunted' or 'not stunted' at age five. Stunting is used as a long-run indicator of child malnutrition, and measured by children having a height (converted to a z-score) below two standard deviations of the median in a WHO age and sex reference population.

To estimate the impacts associated with stunting, we use multivariate regression. Regression analysis uses a set of background characteristics to explain particular outcomes. By including multiple characteristics (as controls) the models estimate the contribution to the overall outcome made by each characteristic.

As a caution, these models are only as good as the observed data they use. There may well be other non-observed characteristics which could affect the relationships observed. Taking account of these non-observables might well affect the predictions noted below.

To allow us to pool the results we include a reference to the cluster in which the child was born (where they were recorded as living in 2002, this absorbs those differences associated with the site and country of origin). Since pooled results might be particularly influenced by one country, we also present results separated by country in summary form in Table 2.

## TABLE 2 SUMMARY OF FINDINGS FROM THE YOUNG LIVES ANALYSIS

| | **Maths score** | **Made a mistake with reading a simple sentence** | **Made a mistake with writing a simple sentence** | **Being in correct grade for age** |
|---|---|---|---|---|
| Pooled sample | -0.982*** | 0.059*** | 0.051*** | -0.081*** |
| SE | (0.127) | (0.011) | (0.010) | (0.012) |
| N | 7,180 | 7,309 | 7,277 | 7,235 |
| Ethiopia | -0.782*** | 0.053** | 0.041** | -0.103*** |
| SE | (0.169) | (0.021) | (0.019) | (0.018) |
| N | 1,707 | 1,774 | 1,770 | 1,762 |
| India | -1.080*** | 0.101*** | 0.078*** | -0.091*** |
| SE | (0.278) | (0.024) | (0.019) | (0.025) |
| N | 1,886 | 1,890 | 1,872 | 1,850 |
| Peru | -0.657** | 0.033 | 0.031 | -0.047*** |
| SE | (0.269) | (0.020) | (0.023) | (0.014) |
| N | 1,781 | 1,816 | 1,817 | 1,816 |
| Vietnam | -1.033*** | 0.026 | 0.034** | -0.066* |
| SE | (0.245) | (0.016) | (0.016) | (0.037) |
| N | 1,806 | 1,829 | 1,818 | 1,807 |

*** p<0.01, ** p<0.05, * p<0.1. The definition of being in the correct grade for age, is that a child is either in, or ahead of, the school grade expected for the age of the child at interview. To interpret these coefficients: the first column shows the impact on a test of 29 maths questions; the last three columns show the independent impact on the chances of making reading or writing mistakes or being in the correct grade associated with stunting. The coefficient of 0.059 (pooled sample, reading) is interpreted as increasing the chances of making a mistake by 5.9 percentage points.
SE = Standard Error; N = Sample Size.

# APPENDIX 2 ESTIMATING THE EQUIVALENT COST OF MALNUTRITION AT A GLOBAL LEVEL

Existing estimates as to the economic impact of malnutrition differ by:

- The type(s) of malnutrition that are focused on
- The conceptual framework/pathway used as to how malnutrition affects GDP (eg, some focus on impacts via poorer health in adulthood, others focus on decreases in productivity through reduced education)
- Whether impacts are estimated at the individual or country level
- The region or country from which the estimate is based (few of them are global)
- The population sub-section to which they refer (eg, some estimates refer just to women)

In fact, most of the studies with reliable estimates refer to the individual level, with only a few aggregate estimates being produced, many of which are very vague in their methodology: the World Bank has stated that costs may be equivalent to 2–3% of GDP; WFP has stated this may be as high as 11% in some Latin American countries.[124]

The World Bank's Nutrition Strategy document: "Repositioning Nutrition as Central to Development"[125] includes a wide-ranging review of various of the different estimates of the economic impact of malnutrition, but does not attempt to systematise or synthesise them. It does not identify one clear statistic as to the precise economic cost, to individuals or countries.

The Copenhagen Consensus has consistently rated actions to address malnutrition as the most cost-effective of all development interventions. The most recent paper on hunger and nutrition from the Copenhagen Consensus group has attempted to quantify the overall benefit:cost ratio of the complete package of direct nutrition interventions (DNIs). They use an estimated increase in income of 23.8 after provision of DNIs, based on the combined fact that malnutrition has been found to reduce productivity by 66% in one paper from IFPRI,[126] and that the DNIs reduce stunting by 36%.[127] They find benefit:cost ratios of between 23.6 and 138.6, depending on pre-existing differences in income levels and growth rates.

We apply a similar methodology. We estimate that stunted children earn 20% less in later life than non-stunted children. This estimate is based on a review of longitudinal studies of the impact of stunting on education outcomes, combined with estimates of the impacts of these education outcomes on wages, which has estimated that stunted children earn 22% less than their non-stunted counterparts.[128] We round down to 20%, which is in line with other previous estimates of the impact of malnutrition on wages,[129] but is a more conservative estimate than the 66% used by the Copenhagen Consensus panel,[130] which itself was based on the most robust available longitudinal study to investigate the economic impacts of stunting.[131]

We apply these estimated losses of income, on a country by country basis, to estimated per capita incomes. For all countries where data is available from the Euromonitor disposable income dataset, we have used this as an estimate of future earnings. Where income data is not available for countries, a proxy is created using the ratio of GNI per capita (for the working population, from the World Bank World Development Indicators) to disposable income for countries at the same income classification. We then calculate the lost earning potential for those children under five years who are currently stunted.

The results of this analysis suggest that by the time today's stunted children reach working age, the difference between their earnings and those of their better-nourished counterparts could be equivalent to $125bn globally.

# ENDNOTES

## EXECUTIVE SUMMARY

[1] Save the Children (2013) *Ending the Hidden Exclusion: Learning and equity in education post-2015*

[2] Save the Children (2012) *The Child Development Index*

[3] See Appendix 1 for details. Young Lives is a longitudinal survey which follows 12,000 children across four countries throughout their lives. For more details see http://www.younglives.org.uk/

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[10] World Food Programme and UN-ECLAC (2007) *The Cost of Hunger: Analysis of the social impact of child undernutrition in Latin America: Central America and the Dominican Republic*

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## 4 CONCLUSION AND RECOMMENDATIONS

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# FOOD FOR **THOUGHT**

## Tackling child malnutrition to unlock potential and boost prosperity

In the past two decades, progress in tackling malnutrition has been pitifully slow.

In this report we demonstrate how investment in nutrition is not only the right thing to do, it is a down-payment on future prosperity.

The evidence we present shows that preventing malnutrition of children and women in the crucial 1,000-day window – from the start of a woman's pregnancy until her child's second birthday – could greatly increase children's ability to learn and to earn, and could boost the prosperity of whole countries.

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